**УДК** 616.127+616.379-008.64
**DOI** 10.17802/2306-1278-2021-10-2S-104-106

# ASSOCIATION OF CARDIOVASCULAR BIOMARKERS WITH MYOCARDIAL AND CORONARY IMAGING CHARACTERISTICS IN PATIENTS HAVING ACUTE MYOCARDIAL INFARCTION AND TYPE 2 DIABETES MELLITUS

**A.S. Vorobev[1], V.V. Kashtalap[3], I.A. Urvantseva[1, 2], K.Yu. Nikolaev[4], L.V. Kovalenko[1], I.D. Astrakhantseva[2]**

*[1] Surgut State University, 1, Lenin Ave., Surgut, Khanty-Mansiysk Autonomous Okrug – Yugra, Russian Federation, 628412; [2] District Cardiology Hospital of the Center for Diagnosis and Cardiovascular Surgery, 69/1, Lenin Ave., Surgut, Khanty-Mansiysk Autonomous Okrug – Yugra, Russian Federation, 628400; [3] Federal State Budgetary Institution «Research Institute for Complex Issues of Cardiovascular Diseases», 6, Sosnoviy Blvd., Kemerovo, Russian Federation, 650002; [4] The Institute of Internal and Preventive Medicine, Federal Research Center, Institute of Cytology and Genetics, the Siberian Branch of the Russian Academy of Sciences, 175/1, B. Bogatkova St., Novosibirsk, Russian Federation, 630089*

| | |
|---|---|
| **Aim** | To assess the dynamic changes and clinical significance of biomarkers of inflammatory processes in patients with acute myocardial infarction (MI) with/or without type 2 diabetes mellitus (T2DM) and primary percutaneous coronary intervention (pPCI) at various stages of treatment. |
| **Methods** | 96 patients with acute MI after pPCI were examined. The level of inflammation markers was measured 4 times: before pPCI (first day from admission to the hospital), on the third day, 7–10 days (before discharge from the hospital) and 40–45 days after pPCI. |
| **Results** | All groups of patients with MI showed an increase in the plasma activity of biomarkers of inflammatory processes. After pPCI for 40–45 days, there is a significant difference in the concentration of biomarkers, depending on the comorbid T2DM presence. Strong associations were found between cardiovascular biomarkers and post-MI cardiac remodeling and coronary atherosclerosis progression. |
| **Conclusion** | The assessment of the levels of biomarkers of inflammatory processes may have additional clinical value in estimating the course of MI, including patients with T2DM at the postinfarction stages. |
| **Keywords** | Myocardial infarction, Diabetes mellitus, Remodeling, Inflammation, Biomarkers |

***Received:*** *18.04.2021;* ***accepted:*** *20.06.2021*

**List of abbreviations**

| | | | |
|---|---|---|---|
| CCT | – coronary computer tomography | MI | – myocardial infarction |
| EF | – ejection fraction | MPO | – myeloperoxidase |
| hs-CRP | – high sensitive C-reactive protein | pPCI | – primary percutaneous coronary intervention |
| LV MCI | – left ventricular myocardial contractility index | T2DM | – type 2 diabetes mellitus |

## Background

The structural and functional rearrangement of the cardiovascular system during the development of myocardial infarction (MI) is based on disorders of systemic regulation of a number of pathophysiological processes, in particular, such as fibrosis, inflammation and coagulation [1, 2]. These processes have particular clinical severity when patients with MI have various comorbid disorders of carbohydrate metabolism. In particular, type 2 diabetes mellitus (T2DM) is now regarded as the equivalent of an atherosclerotic cardiovascular disease. MI combined with T2DM has less favorable clinical course with the formation of early and late postinfarction myocardial remodeling and higher rates of major adverse clinical events [3]. Meanwhile, elevated levels of inflammatory biomarkers are associated with higher cardiovascular risk in post-infarction patients [4, 5].

The aim of the study was to investigate serum levels of inflammatory biomarkers and their association

***Corresponding author:*** *Anton S. Vorobev, a.s.vorobyov@gmail.com; address: 1, Lenin Ave., Surgut, Russian Federation, 628400*

with myocardial and coronary imaging characteristics in patients having ST-elevation acute MI with or without T2DM and undergoing primary percutaneous coronary intervention (pPCI).

## Methods

96 patients with MI were enrolled in the prospective study (55.4±9.8 years old, 47 male: 49 female), 50 with 2TDM (group 1): 46 without T2DM (group 2). Serum levels of high sensitive C - reactive protein (hs-CRP) and myeloperoxidase (MPO) were serially assessed by quantitative immunoenzyme essays in the emergency department before pPCI (stage I), 24 hours after pPCI (stage II), 7–10 days after pPCI at discharge (stage III) and 40–45 days after pPCI during ambulatory follow-up (stage IV). Echocardiography was performed on every stage (I–IV), Coronary Computer Tomography (CCT) – during one-year follow-up. Statistical analysis was performed in STATISTICA software 10.0. In a case of normal distribution, the mean and standard deviation were calculated; when comparing two normally distributed samples, Student's t-test was used. Association between the studied indicators was established by Spearman rank correlation test. The significance level for rejecting the null statistical hypothesis was taken at p values less than 0.05.

## Results

In MI patients with T2DM median levels of hs-CRP (*table*) and MPO were significantly higher, than in MI patients without T2DM on stages I–IV ($p<0.01$). On stage IV in diabetic MI patients higher median values of left ventricular myocardial contractility index (LV MCI) (1.19 vs. 1.06, $p<0.05$), and lower median values of LV ejection fraction (EF) (43% vs. 54%, $p<0.05$) transmitral E/A (0.78 vs. 0.96, $p<0.05$) and tissue-doppler Em (5.8 vs. 7.2, $p<0.05$) were found. Also on stage IV correlation of hs-CRP levels with LV EF ($r = -0.57$, $p<0.05$), LV MCI ($r = 0.53$, $p<0.05$) and transmitral E/A changes ($r = -0,31$, $p<0.05$) established. Using linear regression we found association of CCT-estimated new significant coronary stenoses (≥70%) at one-year follow-up with stage I serum levels of MPO ($Y = 0.64$, $p<0.05$).

Dynamics of the serum levels of hs-CRP (M±SD, mg/L) in the patient groups with acute myocardial infarction

| Stages | Group 1, n = 46 without T2DM | Group 2, n = 50 with T2DM | p |
|---|---|---|---|
| Before pPCI (1) | 4.5±0.8 | 7.5±1.2 | <0.05 |
| 3 days after pPCI (2) | 28.1±1.9 | 49.3±5.9 | <0.01 |
| 7–10 days after pPCI (3) | 5.9±0.4 | 12.0±2.2 | <0.05 |
| 40–45 days after PCI (4) | 2.5±0.3 | 5.0±1.7 | <0.05 |

***Note:*** *M – mean; pPCI – primary percutaneous coronary intervention; SD – standard deviation; T2DM – type 2 diabetes mellitus.*

## Discussion

The results of this clinical study support the hypothesis that patients with MI and T2DM have a higher activity of biomarkers of the systemic inflammatory response, than patients with MI without T2DM. In the group of patients with MI and T2DM, the majority of unfavorable cardiovascular complications in the early posthospital period were recorded according to the data of imaging of the myocardium and coronary arteries (Echocardiography and CCT). There are clinical studies on a separate investigation of hs-CRP or MPO in acute MI patients [4, 5], however, we showed the simultaneous serum activity of both biomarkers in patients with MI and comorbid T2DM in the first one-month four-stage dynamics.

## Conclusions

Hs-CRP and MPO levels assessment in MI with T2DM patients may be useful for early detection of post-infarction LV remodeling and coronary atherosclerotic plaques progression.

## Conflict of interest

A.S. Vorobev declares no conflict of interest related to this article. V.V. Kashtalap declares no conflict of interest related to this article. I.A. Urvantseva declares no conflict of interest related to this article. K.Yu. Nikolaev declares no conflict of interest related to this article. L.V. Kovalenko declares no conflict of interest related to this article. I.D. Astrakhantseva declares no conflict of interest related to this article.

## Funding

State task (2021–2023): "The profile of DNA methylation in the indigenous and alien population of Yugra as an epigenetic biomarker of age-associated cardiovascular pathology and the possibility of its personalized early diagnosis", Scientific and Educational Center, Medical Institute, Surgut State University, Surgut, Russia.

**Author Information Form**

*Vorobiev Anton S.,* PhD, Associate Professor at the Cardiology Department, Surgut State University, Surgut, Khanty-Mansiysk Autonomous Okrug – Yugra, Russian Federation; **ORCID** 0000-0001-7014-2096

*Kashtalap Vasily V.,* MD, Ph.D., Associate Professor, and Head of the Department of Clinical Cardiology, Federal State Budgetary Institution «Research Institute for Complex Issues of Cardiovascular Diseases», Kemerovo, Russian Federation; **ORCID** 0000-0003-3729-616X

*Urvantseva Irina A.,* PhD, Associate Professor, Surgut State University, Surgut, Khanty-Mansiysk Autonomous Okrug – Ugra, Russian Federation; Medical Director, District Cardiology Hospital of the Center for Diagnosis and Cardiovascular Surgery, Surgut, Khanty-Mansiysk Autonomous Okrug – Yugra, Russian Federation; **ORCID** 0000-0002-5545-9826

*Nikolaev Konstantin Yu.,* PhD, Professor, Head of the Laboratory of Urgent therapy, The Institute of Internal and Preventive Medicine, Federal Research Center, Institute of Cytology and Genetics, the Siberian Branch of the Russian Academy of Sciences; **ORCID** 0000-0003-4601-6203

*Kovalenko Ludmila V.,* PhD, Professor, Director of the Medical Institution, Chairperson of the Department of Pathophysiology and General Pathology, Surgut State University, Surgut, Khanty-Mansiysk Autonomous Okrug - Yugra, Russian Federation; **ORCID** 0000-0001-5708-7328

*Astrakhantseva Irina D.,* cardiologist, Head of the Department of Department of hospitalization with a telemedicine center, District Cardiology Hospital of the Center for Diagnosis and Cardiovascular Surgery, Surgut, Khanty-Mansiysk Autonomous Okrug – Yugra, Russian Federation; **ORCID** 0000-0002-1468-9780

**Author Contribution Statement**

*VAS* – contribution to the concept of the study, data interpretation, manuscript writing, approval of the final version, fully responsible for the content

*KVV* – data analysis, manuscript writing, approval of the final version, fully responsible for the content

*UIA* – contribution to the concept of the study, editing, approval of the final version, fully responsible for the content

*NKYu* – contribution to the design of the study, data analysis, approval of the final version, fully responsible for the content

*KLV* – contribution to the concept of the study, editing, approval of the final version, fully responsible for the content

*AID* – data collection and analysis, manuscript writing, approval of the final version, fully responsible for the content

## REFERENCES

1. Frangogiannis N. The inflammatory response in myocardial injury, repair, and remodelling. Nat Rev Cardiol. 2014 May;11(5):255-65. doi: 10.1038/nrcardio.2014.28. Epub 2014 Mar 25. PMID: 24663091; PMCID: PMC4407144.

2. Gabriel-Costa D. The pathophysiology of myocardial infarction-induced heart failure. Pathophysiology. 2018 Dec;25(4):277-284. doi: 10.1016/j.pathophys.2018.04.003. Epub 2018 Apr 18. PMID: 29685587.

3. Edqvist J., Rawshani A., Adiels M., Björck L., Lind M., Svensson A., Gudbjörnsdottir S., Sattar N., Rosengren A. Contrasting Associations of Body Mass Index and Hemoglobin A1c on the Excess Risk of Acute Myocardial Infarction and Heart Failure in Type 2 Diabetes Mellitus. J Am Heart Assoc. 2019 Dec 17;8(24):e013871. doi: 10.1161/JAHA.119.013871. Epub 2019 Dec 10. PMID: 31818213; PMCID: PMC6951061.

4. Ladeira RT, Baracioli LM, Faulin TE, Abdalla DS, Seydell TM, Maranhão RC, Mendonça BB, Strunz CC, Castro Id, Nicolau JC. Unrecognized diabetes and myocardial necrosis: predictors of hyperglycemia in myocardial infarction. Arq Bras Cardiol. 2013 May;100(5):404-11. English, Portuguese. Epub 2013 Apr 19. PMID: 23598457..

5. Khan S., Kelly D., Quinn P., Davies J., Ng L. Myeloperoxidase aids prognostication together with N-terminal pro-B-type natriuretic peptide in high-risk patients with acute ST elevation myocardial infarction. Heart. 2007 Jul;93(7):826-31. doi: 10.1136/hrt.2006.091041. Epub 2006 Dec 28. PMID: 17194712; PMCID: PMC1994475.

***To cite:*** *Vorobev A.S., Kashtalap V.V., Urvantseva I.A., Nikolaev K.Yu., Kovalenko L.V., Astrakhantseva I.D. Association of cardiovascular biomarkers with myocardial and coronary imaging characteristics in patients having acute myocardial infarction and type 2 diabetes mellitus. Complex Issues of Cardiovascular Diseases. 2021;10(2S): 104-106. DOI: 10.17802/2306-1278-2021-10-2S-104-106*