Physical activity is a useful tool in the prevention of many diseases. Hospitalization after strenuous exercise from cardiac or noncardiac causes, even in young athletes without previous symptoms, can occur. These situations are not uncommon and e.g. after completing a half-marathon clinical symptoms suspicious from cardiac etiology can be present. Limitations of biomarkers used in daily clinical practice can lead to misinterpretation with additional consequences to the patient's outcome. Our goal was to describe changes of markers used in daily clinical practice after extreme physical activity and after exercise under laboratory conditions.

We performed two studies in cooperation with Department of cardiology and Department of sports medicine. The goal of our first study was to examine high sensitivity troponin I (hsTnI), galectin-3, cystatin C, NGAL and ultrasensitive CRP (uCRP) after extremely long run during the competition in long distance running. The goal of our second study was to examine high-sensitivity troponin T (hsTnT) and hsTnI, creatinine and cystatin C, and urine albumin and NGAL after a standardized two-hour treadmill run under laboratory conditions and to find possible connection with echocardiographic, laboratory and other assessed parameters. The second goal of study under laboratory conditions was to compare changes in hsTnI and hsTnT with ESC 2015 0/1 rapid rule-out and rule-in algorithm for non-ST elevation myocardial infarction and to evaluate changes in renal parameters.

37 runners (5 females) were included in our first study. The age of runners [(median (min–max)] was 39 (22–66) years. Runners run 100 (42.2–181) km. Two blood samples were collected and concentrations of hsTnI, NGAL, cystatin C, galectin-3 and uCRP were measured.

19 trained men enrolled in our second study undergone normalized two hour-long treadmill run. The age of runners was 37 (24–48) years. Concentrations of hsTnT, hsTnI levels, creatinine and cystatine C were assessed before the run, 60 minutes after the start, at the end of the run, one hour after the end of the run and 24 hours after the end of the run. Concentrations of urine creatinine, albumin and NGAL were assessed before the run, 60 minutes after the run and 24 hours after the run. Changes of all parameters were calculated and correlation coefficients between changes in hsTnT and hsTnI values and echocardiographic, anthropometric and other laboratory parameters were calculated. The multiple linear regression model was used to find the explanatory variables for hsTnT and hsTnI changes. Values of hsTnT and hsTnI were evaluated using 0h/1h algorithm for non-ST elevation myocardial infarction diagnosis.

Results of our first study suggests, that extremely long run leads to statistically significant changes in concentrations of hsTnI, NGAL, cystatin C, galectin-3 and uCRP, however only in case of uCRP correlation with running distance and time of run was found. Statistically

significant negative correlation was found between hsTnI and cystatin C changes (r = -0.32 p = 0.05).

In our second study, changes in hsTnT and hsTnI levels were statistically significant. One hour after the end of the run values of hsTnT were higher in 68 % of cases and values of hsTnI were higher in 21 % cases than 99. percentile (for whole population). 24 hours after the run were concentrations in 1 case of hsTnT and 2 different cases of hsTnI higher than before the run. According to the multiple regression model changes in both troponins can be explained by relative left wall thickness, training volume, body temperature after the run and creatinine changes.

According to the 0h/1h algorithm, in case of hsTnT, none of runners was excluded, 5 (26 %) runners were stratified into “positive” group and 14 (74 %) cases were stratified into “observe” group. In case of hsTnI, nobody was excluded, 4 (21 %) runners were stratified into “positive” group and 15 (79 %) cases were stratified into “observe” group.

The design of our first study is similar to other studies assessing changes of laboratory parameters after running, however is unique by number of runners undergoing extremely long run. Results of our first study suggests that extreme run leads to changes in all mentioned parameters, however only in case of uCRP changes of concentrations correlated with distance and time of run.

Our second study suggests, that relative left ventricle wall thickness, creatinine changes, training volume and body temperature after the run can predict changes in hsTnT and hsTnI levels. Increased levels of cTn can be present even in cases without extreme or long intensity exercise. When medical attention is needed after physical exercise, cTn levels should be tested only when clinical suspicion and the patient’s history indicate a high probability of myocardial damage, however interpretation of results in these cases can be challenging. Finally, changes in renal parameters can be observed, however these changes are dependent on the design of the study and biomarkers.

Our work leads to interesting conclusions. Changes in cardiac troponin concentration does not have to be caused by intensive or high intensity exercise. Additionally, we created model partly explaining changes in cardiac troponin changes.

Keywords: high sensitivity troponin T, high sensitivity troponin I, NGAL, galectin-3, running, standardized exercise, echocardiography