GLYCOGEN PHOSPHORYLASE ISOENZYME BB AS A MARKER OF MYOCARDIAL STUNNING IN WATER POLO PLAYERS

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Abstract

Background: In past years, several studies have suggested myocardial damage after extreme exercise due to increased post exercise levels of cardiac markers which return to baseline levels within 24 hours. Recently, the importance of the process labeled as myocardial “stunning” caused by ischemia or coronary vasospasm which is transient in nature and does not result in necrosis and permanent cellular damage has been emphasized. This study was performed to test if this extremely strenuous sport is hazardous to cardiovascular health of adolescent male water polo players. To this end, we measured serum concentration of the early marker of myocardial ischemia glycogen phosphorylase isoenzyme BB (GP-BB).

Methods: Total of 20 water polo players was studied. They were randomly divided in two groups: exercise group and non-exercise that served as a control group. GP-BB concentration was measured at different time points: baseline, and 1, 30 and 60 minutes following exercise.

Results: Increased GP-BB concentration was found in 40% of water polo players in 1 and 30 minutes post exercise, but in only 10% one hour later. Obtained concentration 1 and 30 minutes following exercise significantly positively correlated (r=0.895; p<0.001) as well as concentrations at 30 and 60 minutes (r=0.697; p<0.03).

Conclusion: Glycogen phosphorylase isoenzyme BB could be a good marker of myocardial stunning caused by ischemia or coronary vasospasm which is transient in nature and does not result in necrosis and permanent cellular damage in water polo players.

Key words: glycogen phosphorylase BB, water polo players, myocardial stunning

INTRODUCTION

At present, the risk of myocardial damage by endurance exercise is under debate because of reports on exercise-associated increases in cardiac biomarkers which are typically elevated in patients with acute myocardial infarction and chronic heart failure (1). Emerging evidence suggests that prolonged strenuous exercise may be associated with “cardiac fatigue” or “cardiac damage”, although the clinical implications remain obscure (2).

In recent years, special attention has been drawn to glycogen phosphorylase, specifically the BB isoenzyme (GP-BB) as a specific serum marker of myocardial ischemia (3). This isoenzyme is present in human myocardium, in addition to the brain. Therefore, in the presence of an intact blood-brain barrier, serum GPBB is derived from the myocardium only (4,5). This results in elevating of GPBB early in the blood within short time period of myocardial ischemia (6,7,8). Moreover, preliminary human studies suggest a higher sensitivity of GPBB compared to other cardiac markers. Additionally, GPBB is not dependent on cellular death and necrosis for release, and thus is a true marker of ischemia (9).

Subject of our interest is water polo sport as the oldest continuous Olympic team sport. Water polo is a physically demanding sport; action is continuous, and players commonly swim three kilometres or more during four periods of play (10,11,12). Therefore, in this study we examined if this extremely strenuous sport was hazardous to cardiovascular health of adolescent male water polo players.
MATERIAL AND METHODS

Total of 20 water polo players was studied. They were randomly divided in two groups. The first group was exposed to a strenuous exercise (exercise group) whilst the second group served as a control (non-exercise group). In order to avoid the selection bias, the groups were matched for age and level of physical stamina. Moreover, we examined only players from one team who trained under identical conditions. Blood samples (5 ml) from peripheral vein (cubital vein). blood samples were obtained at the following time points: baseline (before the exercise), 1 minute following the exercise (same in non-exercise group), 30 minutes following the exercise (same in non-exercise group) and 1 hour following the exercise (same in non-exercise group). Serum was collected and stored in triplicate (at least 0.5 ml) aliquots with appropriate labeling and then were frozen (less than 25°C). The concentration of GP-BB was determined in duplicate by ELISA (Diagenics, USA). At the same time points measured blood pressure and heart rate were measured. Study was approved by the Ethical Committee of Faculty of Medicine University of Nis, Serbia.

All analyses were performed using the Statistical Package for the Social Science (SPSS), statistical software for Windows, Version 12.0 (SPSS Inc., IL, USA). The difference were assessed by Student’s t-test and Pearson’s correlation test. Probability (p) less than 0.05 and 0.01 was considered significantly different and less than 0.001 highly significantly different.

RESULTS

Two analyzed groups, exercise and non-exercise, were matched in relation to age, body weight, body height, body mass index (BMI) and length of years in water polo sport. Mutual these two groups did not differ in mean value of diastolic and systolic blood pressure as well as heart rate frequency.

Basal concentration of GP-BB between groups did not differ significantly.

Exercise-induced changes in concentration of GP-BB were shown in figure 1.

One and 30 minutes following strenuous exercise 40% of water polo players had increased GP-BB concentration and only 10% 60 minutes after. Strenuous exercise induced a significant increase GP-BB concentration immediately after strenuous exercise, precisely 1 minute after (t=3.205; p<0.011) in comparison to their basal values. Increased concentrations are maintained at the same rate in the next 30 minutes. Obtained concentrations following 1 and 30 minutes were in significantly positive correlation (r=0.895; p<0.001). In the next half hour GP-BB concentration is decreasing but still significantly positive correlation obtained between values 30 and 60 minutes following strenuous exercise (r=0.697; p<0.03).

None in the non-exercise group showed elevated concentration of GP-BB. Exercise did not induce statistically significant difference, although higher concentrations were obtained in comparison to non-exercise group.

We also analyzed whether there was a connection between GP-BB concentration to the values of blood pressure and heart rate frequency. Our results indicate only a significant negative correlation to the diastolic pressure 1 (r=-0.696, p<0.05) and 30 minutes (r=-0.644, p<0.05) following exercise.

DISCUSSION

The question whether endurance exercise is associated with structural or functional damage of the human heart is of utmost importance for physicians involved in the medical care and guidance of endurance athletes. If myocardial damage occurs with prolonged exercise, this would result in the release of myocardial cellular proteins into the general circulation, where they can be detected (13). In the past years, several studies have suggested myocardial damage after extreme endurance exercise due to increased post exercise levels of cardiac troponin I and T, natriuretic peptide (BNP), ischemia modified albumin (IMA), glycogen phosphorylase isoenzyme BB (GPBB), creatinin kinase MB (CK-MB) which returned to baseline values within 24 h (14,15,16,17). Recent studies, particularly emphasize the importance of the process labeled as myocardial “stunning” caused by ischemia or coronary vasospasm (18) which is transient in nature and does not result in necrosis and permanent cellular damage (13).

According to published studies, GP-BB was highly specific and highly sensitive marker of early myocardial ischemia indicating ischemic “minimal” myocardial damage at an early stage (6,7,8). Its release requires both, burst in glycogenolysis and concomitantly increased plasma membrane permeability (19). Nevertheless, there are a few studies examining exercise-induced myocardial ischemia in competitive sports by measuring the concentration of GP-BB, particularly in water polo sport. According to the literature, GP-BB concentration increases immediately after strenuous exercise like 21 km run, cross country running or cycling (17,20,14). One minute following strenuous exercise 40% of water polo players showed elevated GP-BB concentration. Although there is comprehensive information on traditional biomarkers of cardiac damage following exercise, less is known on the kinetics of innovate markers, including GP-BB. Thus, 21 km run causes significant increase in GP-BB concentration immediately after running and returns to baseline values 6 hours after (17). In our study, we analyzed the dynamics in first hour following strenuous exercise. According to our results, 40% still had increased GP-BB concentration after 30 min, and only 10% after 60 min. Osbakken and Locko employed stress-redistributed thallium scans and reported possible evidence of myocardial perfu-

Figure 1. Exercise induced changes in concentration of GP-BB in water polo players.
sion defects in trained athletes after 40±7 minutes of fatigue-limited sub maximal bicycle exercise (21).

Concerning the structure of water polo players motion during game, 35% of overall time the players is in quasi-horizontal phase (all swimming at all levels of intensity during game), whereas the remaining 65% of the time in quasi-vertical phase (vertical position achieved by leg work known as water polo cycling) (22). Myocardial blood flow is stopped or greatly reduced during systole based on contractile force so that during exercise coronary perfusion in diastole increases due to a dramatically increased intravascular pressure (23).

GP-BB concentrations were in significant, negative correlations with diastolic blood pressure in 1 and 30 minutes following strenuous exercise.

CONCLUSION
Glycogen phosphorylase isoenzyme BB could be a good marker of myocardial „stunning” caused by ischemia or coronary vasospasm which is transient in nature and does not result in necrosis and permanent cellular damage in water polo players.

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