Acute Changes in Carotid Arterial Blood Velocity Immediately after the Cessation of Exercise

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1 OBJECTIVES

Changes in hemodynamic parameters following exercise have been widely reported. However, the changes in carotid arterial blood flow have not been well documented. The purpose of this study was to examine acute changes in carotid arterial blood velocity immediately after the cessation of exercise.

2 METHODS

Twenty-four young healthy men were registered (age: 21.3 ± 1.6 years). The cardiopulmonary exercise test was conducted starting at an initial workload of 20 W and lasting for 2 minutes with a strength ergometer; thereafter, the workload was increased stepwise by 20 W at 1-minute intervals. Electrocardiogram was continuously monitored. The criteria for the endpoint included increase of heart rate to [(220-age) ×0.8 (bpm)], and achievement of maximum fatigue or the impossibility of continuing exercise. Then cooling down was conducted at 20 W following exercise for 150s. We measured the blood velocity in the carotid artery at 60s and 120s after the cessation of exercise with a Doppler system. We also measured carotid arterial diameter by echo tracking (Niki, 2002). Carotid arterial stroke volume (FV) was obtained by integrating the product of blood velocity and arterial cross-section over systole. Carotid arterial output (Q) was given as FV times heart rate. The data were analyzed by the repeated measures ANOVA and Bonferroni post test.

3 RESULTS

Reductions in systolic/ diastolic blood pressure were significant at 60s and 120s after the cessation of exercise (93 ± 3 / 84 ± 3% , 88 ± 4 / 84 ± 3%, respectively) compared with the values at the cessation of exercise (100%). The reduction in heart rate was also significant at 60s and 120s after the cessation of exercise (84 ± 7% and 78 ± 7%, respectively). On the contrary, the maximum blood velocity increased significantly to 121 ± 24 % and 116 ± 27% at 60s and 120s after the cessation of exercise, respectively (Fig. 1). FV also increased significantly to 128±40% and 129±42%. However, Q remained unchanged.

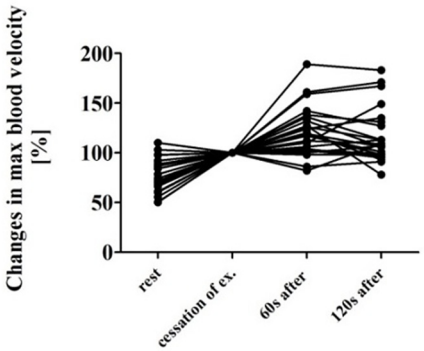

Figure 1: The maximum carotid arterial blood velocities at rest, at the cessation of exercise, 60s and 120s after the cessation of exercise. Data are displayed as percent, normalized to the velocity at the cessation of exercise.

4 DISCUSSION

Following exercise, syncope is often reported (DiVasta, 2004; Natarajan, 2006; Vettor, 2015). However, its hemodynamic mechanism is not yet fully understood. The responses in blood flow (or velocity) following exercise are not well documented even though there has been extensive work done on the blood pressure and heart rate responses. The blood pressure and heart rate started to decrease immediately after the cessation of

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exercise as reported so far (Muendel, 2015). On the other hand, carotid arterial blood velocity increased further after the cessation of exercise. Carotid arterial stroke volume (FV) also increased, which compensated for the reduction in output due to the decrease in heart rate. Thus, carotid arterial output (Q) remained unchanged. We consider that this is a mechanism to prevent hemodynamic disturbance after cessation of exercise.

5 CONCLUSIONS

Immediately after the cessation of exercise, blood pressure and heart rate decreased. However, carotid arterial blood velocity and stroke volume increased significantly. As a result carotid arterial output remained unchanged. This is considered to be a mechanism to prevent post-exercise hemodynamic disturbances.

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