Peculiarities of Arterial Blood Flow in Response to Dynamic and Static Types Exercising
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Introduction. Cardiovascular system responds to various stimulus. Skeletal muscle contractions are one of the major physiological stimulus activating reactions of cardiovascular system. Dynamic type of exercising impact increase of muscular blood flow more than static type of workloads and it is believed this is due to more efficient muscle pump function. Muscle veins and arteries are mechanically pressed by muscle contractions [1]. Static and dynamic endurance at 50% or 75% of the maximal voluntary contraction (MVC) is an indicator of the working capacity abilities. The aim of this study was to reveal peculiatities of arterial blood flow in response to dynamic and static types of exercising.

Organization and methods. The first experiment with a static 50% and 75% MVC exercise to inability to continue this work, the second experiment with a dynamic 50% and 75% MVC exercise to inability to continue this work and the third experiment with 75% MVC static 30 second (s) exercise. Well trained middle and long distance runners (n = 36) take part in this study. Each experiment involved 12 subjects. The knee of the working leg was fixed at the angle of 90° and the feet ankle – at 70°. Calf muscles MVC was measured three times and charged at a higher value. Blood flow in the calf muscles was determined by venous occlusion plethysmography.

Results. First experiment. While performing the static exercise 50% of MVC the intensity of blood flow after 20 min adaptation was 2.7 ± 0.3 mL / 100 mL / min. Immediately after static physical load blood flow intensity increased to 43.1 ± 5.2 mL / 100 mL / min and other blood flow intensity measurements decreased insignificantly but did not reach the baseine.

While performing the static exercise 75% MVC blood flow intensity of initial size after 20 min adaptation was 2.6 ± 0.2 mL / 100 mL / min. Immediately after the maximum muscular endurance blood flow intensity increased to 49.5 ± 5.1 mL / 100 mL / min, but the highest values of blood flow intensity was on 23 s (52.6 ± 5.6 mL/100 mL/min), and other blood flow intensity measurements decreased insignificantly but did not reach the baseine (see Fig. 1).
**Fig. 1.** Arterial blood flow intensity change after static 50% MVC and 75% MVC exercise to inability to continue this work.

**Second experiment.** While performing the dynamic exercise at 50 % MVC blood flow intensity after 20 min was 2.2 ± 0.3 mL/100 mL/min. Immediately after the maximal exercise blood flow intensity increased to 52.0 ± 3.4 mL/100 mL/min. Further measurements of blood flow intensity showed the decrease of blood flow intensity but the baseline did not reach.

**Fig. 2.** Arterial blood flow intensity change after dynamic 50% MVC and 75% MVC exercise to inability to continue this work.

* - p < 0.05, compared with the dynamic 50% MVC physical load.

**While performing** dynamic exercise at 75 % MVC of blood flow intensity after 20 min was 2.4 ± 0.2 mL/100 mL/min. Immediately after the maximal exercise blood flow intensity increased to 50.4 ± 4.5 mL/100 mL/min. but the
highest values of blood flow intensity was on 23 s (51.2 ± 4.6 mL/100 mL/min). And other blood flow intensity measurements decreased insignificantly but did not reach the baseline (see Fig. 2).

Third experiment. While performing the workload with 50 % and 75 % MVC static exercise to inability to continue this work, and 75 % MVC 30 seconds static exercise blood flow intensity increased analogously. In group with 75 % MVC 30 seconds static exercise blood flow intensity decreased significantly faster than in the group with 50% and 75% MVC static exercise to inability to continue this work, but did not reach the baseline (see Fig. 3).

Fig. 3. Changes of arterial blood flow after the static 50% MVC, 75% MVC up to inability to continue the task and dosage of 75% MVC 30 s physical exercise. Note.* - p < 0.05, compared with the static 50% and 75% MVC physical load.

Discussion. Independently of applied type of physical activity and duration of exercising arterial blood flow intensity increased significantly. The highest values of the blood flow intensity were registered immediately after exercise. However, the blood flow intensity of 50% MVC static physical load on 23 s where less than in 75% MVC static physical load. Blood flow intensity of working muscles after static physical work depending on the intensity of physical workloads [1].

After the dynamic 50% and 75% MVC physical loads the largest blood flow intensity values are immediately after physical load. Changes of arterial blood flow after dynamic physical loads, in most cases, are significantly higher in 50% MVC physical loads to inability to continue this work. Recovery at the 77 s in the 75% MVC dynamic physical load blood flow intensity decreases more to the end of the registration to compare with 50% MVC physical load. Blood flow intensity depends on the physical volume workloads. When starting physical load arterial blood flow is intensifying from the beginning of the exercise and after exercise continues to increasing. This quick intensification of the blood flow influences the mechanical effect of the muscle pump, abnormal perfusion,
increased blood pressure gradient in capillary network [2]. After the dynamic and static 75% MVC physical load arterial blood flow reached the highest values were not immediately after exercise, but the 23 s and later. Why is not the largest circulation immediately after exercise, and after some time? According to Sparks [3] and Grant [4], studies have found that during exercise the arterial blood vessels were heavily compressed, so it takes time for the arterial blood vessels filled with blood. When it fills with blood we registered the highest values of arterial blood flow.

Blood flow intensity after 30 s of static exercise significantly increases and at the recovery decreases significantly faster compared with 75% and 50% MVC static exercise to inability to continue this work. Blood flow intensity level after exercise depends on the duration of isometric contraction at a uniform physical effort.

**Conclusion.** There no differences between increase of arterial blood flow while performing a workloads at 75% and 50% MVC in static or dynamic type of exercising up to inability to continue the task or during the tasks longer than 30s. The main differences between impacts of applied workload to cardiovascular system were observed during the period of recovery after exercising. Significantly faster recovery of blood-flow intensity after dynamic type of workloads reflects internal muscular changes occurred in muscular tissue during exercising.

**References**


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The aim is to analyze arterial blood flow intensity response to dynamic and static exercises. The first experiment with a static 50% and 75% MVC exercise to inability to continue this work, the second experiment with a dynamic 50% and 75% MVC exercise to inability to continue this work and the third experiment with 75% MVC static 30 second (s) exercise. Blood flow intensity significantly faster recovering after 75% MVC 30 seconds static physical load comparison with 75% and 50% MVC static exercise to inability to complete fatigue.