Histamine and Cardiovascular Adaptation to Endurance Exercise

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Introduction

- Repeated exercise stress causes an increase in aerobic work capacity by increasing oxygen delivery to peripheral tissue as well as improving markers of vascular health such as decreasing arterial stiffness and decreasing systemic blood pressure (Green, 2009). The mechanisms behind adaptation to exercise are still relatively not well described.
- Histamine is released during exercise and exerts a wide range of effects on the vascular system and may be an important molecular transducer contributing to many adaptations that accompany chronic exercise training (Romero *et at*, 2016).
- Therefore, the purpose was to determine whether a histamine receptor blockade will reduce the effects of exercise training on vascular function.
- **Hypothesis:** histamine receptor blockade will demonstrate lower levels of vascular adaptations with exercise training compared to the control group.

Methods

Subjects:

- Subjects were healthy non-smokers, characterized as sedentary and were randomly assigned to either placebo-control or histamine receptor blockade group.

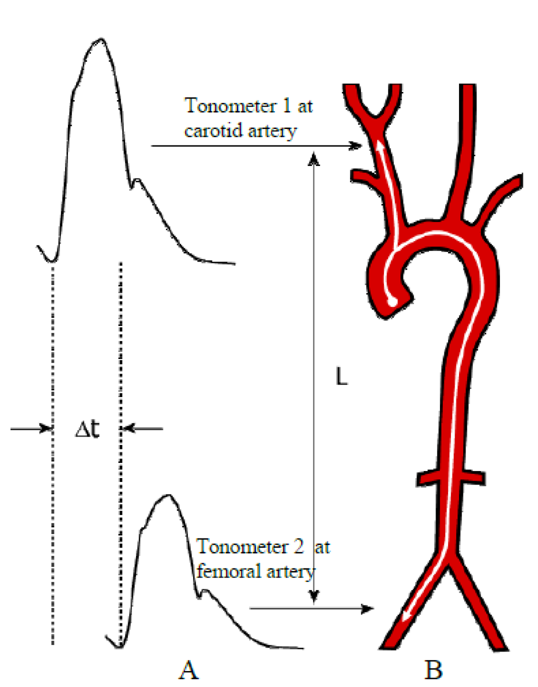
Exercise Training Intervention:

- For the 6-week period, subjects completed a total of 21 exercise sessions.
- 18 of the exercise sessions were of continuous moderate-intensity cycling (60% VO_{2peak}) for 60 minutes.
- 3 of the exercise sessions were 30 minute sessions of high intensity interval training at 90% and 30% VO_{2peak}, relatively.

Measurements:

- **Peak oxygen consumption** (VO_{2peak}) was measured using an incremental cycling exercise test. Oxygen consumption was measured with a mixing chamber and gas analyzer (Parvomedics, Sandy, UT, USA).
- **Arterial stiffness** was assessed by pulse wave velocity (PWV) between the carotid and femoral conduit arteries and the brachial and posterior tibialis (ankle) arteries. One tonometer was placed on each artery simultaneously (see part B of image 1). PWV was calculated by dividing the distance between tonometers by transient time of the pulse.

$$PWV = \frac{distance\ (cm)}{\Delta t\ (s)}$$



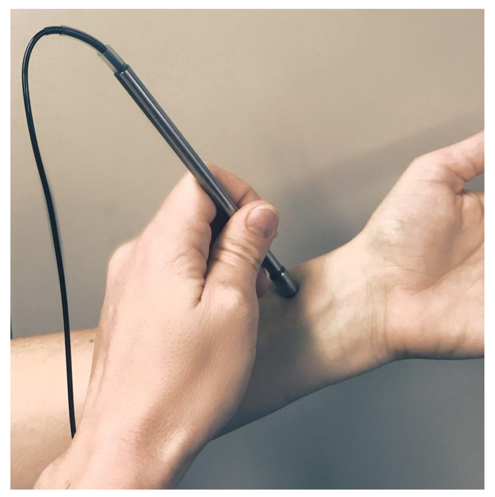


Image 1: Demonstrating PWV technique. Part A demonstrating the recorded pressure wave form tracing at the carotid artery and the femoral artery. Dt demonstrating the time delay between the two systolic foot upstrokes. Part B demonstrates where on the body each tonometer was placed (Zanoli *et al.*, 2015).

Research Timeline

PRE day 1	7 sessions of moderate intensity aerobic cycling (60% VO_{2peak}) for 1 hour	**MID1** day 12	6 sessions of moderate intensity aerobic cycling (60% VO_{2peak}) for 1 hour and 1 session of high intensity interval training for 30 minutes (90% and 30% VO_{2peak}	**MID2** day 24	4 sessions of moderate intensity aerobic cycling (60% VO_{2peak}) for 1 hour and 3 sessions of high intensity interval training for 30 minutes (90% and 30% VO_{2peak}	**POST** day 46
VO_{2peak} PWV of central arteries and peripheral arteries		VO_{2peak} PWV of central arteries and peripheral arteries		VO_{2peak} PWV of central arteries and peripheral arteries		VO_{2peak} PWV of central arteries and peripheral arteries

Table 1: Schematic of the measurements made on each day as well as the number and type of exercise sessions between each of the measurement days.

Aerobic Capacity and Arterial Stiffness Results

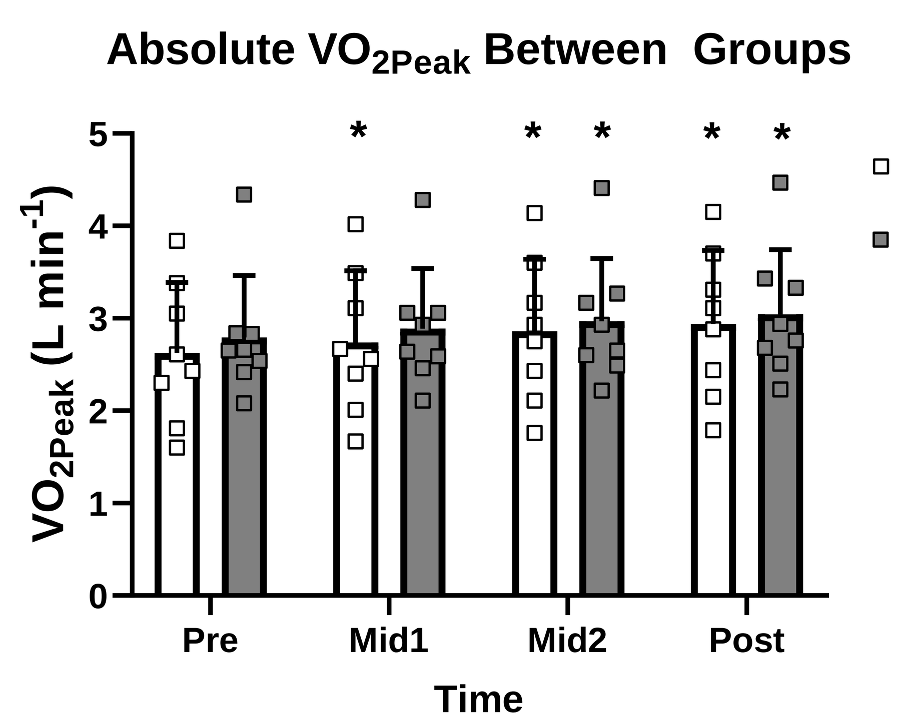


Figure 1 demonstrates measurements VO_{2peak} comparing the control group (n=8) and the blockade group (n=8). Statistically different ($p < 0.05$) between PRE and POST.

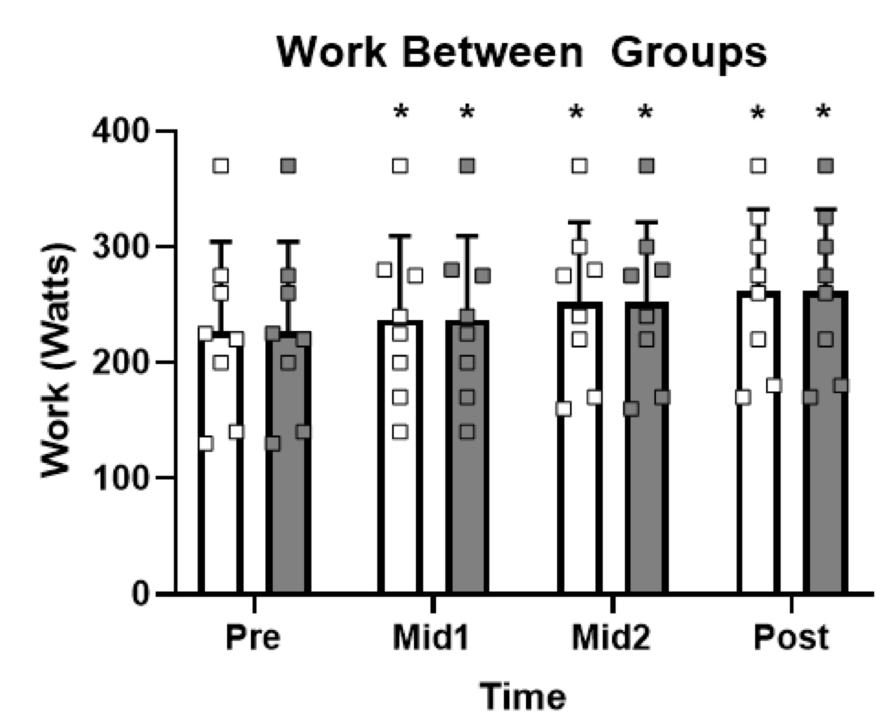


Figure 2 demonstrates the maximum workload completed comparing the control group (n=8) and the blockade group (n=8). Statistically different ($p < 0.05$) between PRE and POST.

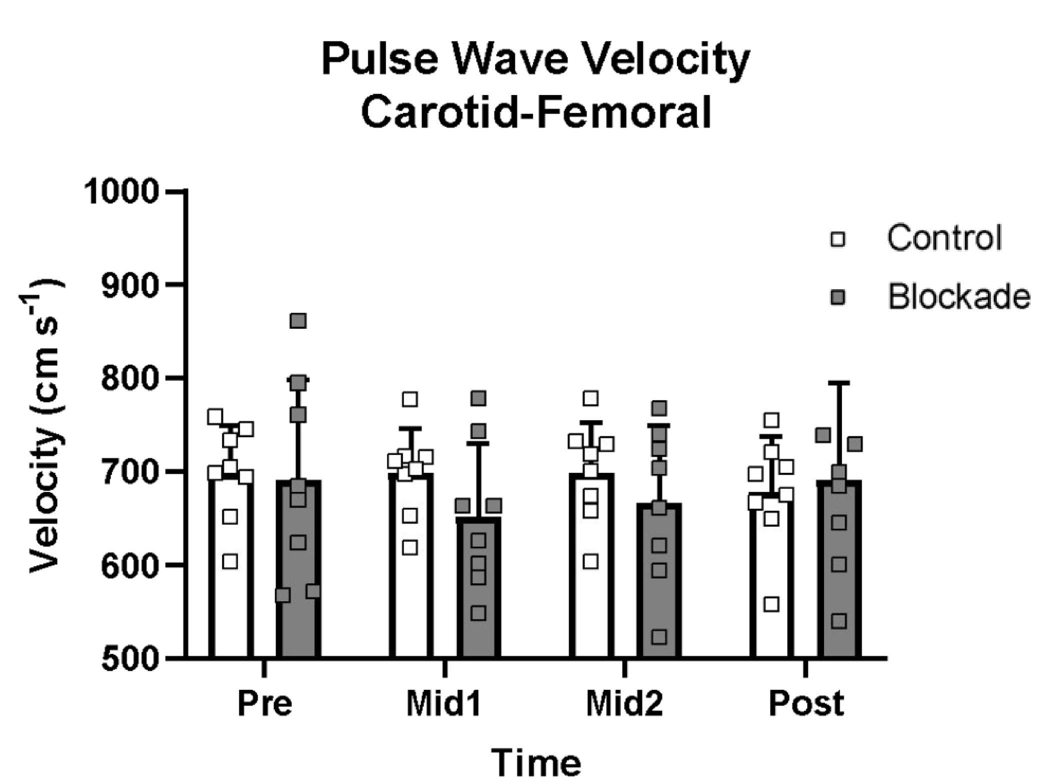


Figure 3 demonstrates the absolute values of PWV of conduit arteries from each measurement day. Comparing the control group (n=8) and the blockade group (n=8). No significant changes recorded.

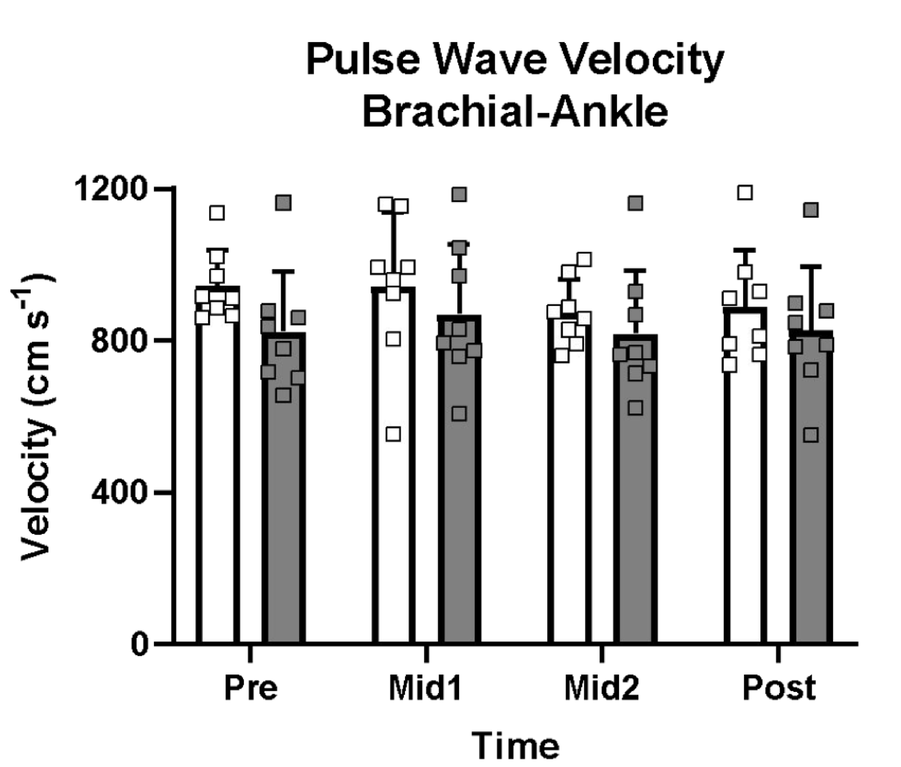


Figure 4 demonstrates the absolute values of PWV of peripheral arteries from each measurement day. Comparing the control group (n=8) and the blockade group (n=8). No significant changes recorded.

Conclusions

- There was an increase in aerobic work capacity among both groups. Figure 1 shows that absolute **VO_{2peak} increased** significantly throughout the duration of the training regimen. Maximal **workload performance increased** significantly (figure 2).
- **PWV measurements did not change with exercise training or between groups**.

Discussion

- **We reject the null hypothesis**. Histamine receptor blockade did not have an effect on changes in aerobic work capacity or arterial stiffness with exercise training.
- This could have occurred due to the subject population and the duration and intensity of the exercise training. The subjects were all young (25±4 yr) and healthy individuals. In studies that reported a decrease in PWV, subjects (50±3 yr) sedentary men. The duration of the training regimen was 16 weeks long of moderate-intensity exercise training (Ashor et al. 2014). Therefore, we might have seen different results with a different population and a longer training period.
- Another study that would increase our understanding of adaptions resulting from increasing aerobic capacity would be in examine the changes in oxygen utilization in working skeletal muscle.

References

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