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Research Paper

Influence of aerobic exercise training on cardiovascular and endocrine-inflammatory biomarkers in hypertensive postmenopausal women☆

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ABSTRACT

Given that few studies have examined the interaction between endocrine-inflammatory mediators and aerobic exercise training in hypertensive postmenopausal women, the aim of this study was to investigate whether aerobic exercise training (AET) for twenty-four sessions would alter cortisol, leptin and interleukin-1β (IL-1β) levels. To further analyze endothelium function in response to AET, we also examined redox state as well as NO/cGMP pathway in this population. Eighteen hypertensive postmenopausal women finished this study. AET program consisted of 24 sessions in treadmill, 3 times per week, duration of 30 up to 40 min for each session, for 8 weeks at intensity of 100% of the MLSS according to previous incremental test. Heart rate was monitored in all studied time (resting and during exercise sessions). After 48 h of the last exercise session, blood samples were collected for biochemical analyses (levels of cortisol, leptin, IL-1β, nitrite/nitrate (NOx^-), cGMP, malondialdehyde (MDA) and asymmetric dimethylarginine (ADMA); superoxide and catalase activity). We also measured systolic and diastolic blood pressure. A significant reduction in body mass was observed. As expected, systolic and diastolic blood pressure values were significantly reduced after AET in hypertensive women. We also found a marked increase in NOx^- levels as well as cGMP concentration in trained women, approximately 37.7 and 30.8%, respectively. No changes in cortisol, leptin, ADMA and IL-1β levels were observed after AET. Similarly, MDA levels and catalase activity were not affected by AET. In contrast, a marked increase in SOD activity was found (86.6%). In conclusion, our findings show that aerobic exercise training for twenty-four sessions promoted a significant reduction in blood pressure by activating NO/cGMP pathway as well as by promoting an up-regulation of SOD activity without changing in cortisol/leptin levels in postmenopausal hypertensive women.

Introduction

Epidemiological studies have shown that the incidence of cardiovascular diseases (CVD) in women increases dramatically after menopause [1,2]. However, the underlying mechanisms are not yet fully clarified. Several hypotheses have been proposed to explain this phenomenon in postmenopausal women. Estrogen deficiency has been pointed out to play a major role, but its deficiency partially explains the increased incidence of CVD since hormone replacement therapy did not prevent or mitigated cardiovascular events in this population [3,4]. Oxidative stress is another explanation, where increased production of the inflammatory mediators would lead to a massive production of reactive oxygen species, which in turn, resulting in endothelium dysfunction with decrease in nitric oxide (NO) production or its bioavailability to the cells [5]. However, some studies found a positive association between CVD and inflammatory mediators [6–8] whereas others failed to detect any association [9] in climacteric phase. The hypothalamic-pituitary-adrenal axis has also been linked to the higher incidence of CVD in postmenopausal women [10,11]. Nevertheless, the number of studies examining the interaction between menopause status and glucocorticoids is scarce.

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Therefore, the higher incidence of CVD in postmenopausal women still a complex issue and further studies should be carried out to look at the insight mechanisms as well as to get more information in an attempt to prevent cardiovascular events in this population. On the other hand, a plethora of studies has shown that physically active subjects have more longevity with reduction of morbidity and mortality [12,13]. Given that few studies have examined the interaction between endocrine-inflammatory mediators and aerobic exercise training in hypertensive postmenopausal women, the aim of this study was to investigate whether aerobic exercise training for twenty-four sessions would alter cortisol, leptin and interleukin-1β levels. To further analyze endothelium function in response to exercise training, we also examined redox state as well as NO/cGMP pathway in this population.

Methodology

Study participants

This study was approved by the Ethical Committee of Institute of Bioscience at the University of São Paulo State (UNESP). All the volunteers were recruited through advertisements in the surrounding area of UNESP. A total of thirty-two volunteers were eligible to participate in the study. After all screening test, only eighteen women finished the study. Postmenopausal status was determined as the absence of menstruation for at least 1 year under natural or surgical causes were classified as hypertensive according to previous medical diagnosis (systolic blood pressure: 140–159 mm Hg, diastolic blood pressure: 90–99 mm Hg or using anti-hypertensive). The inclusion criteria of this study were: to be hypertensive; body mass index $\leq$30 kg/m^2; sedentary ($<$150 min of moderate physical activity per week or $<$60 min of vigorous physical activity per week). The exclusion criteria were: smoking, taking hormone replacement therapy, diabetic, cardiovascular disease (stroke, heart failure); renal dysfunction; other condition that precludes the practice of physical exercise. Before starting the protocol, volunteers were informed about the procedures and risks of the study and signed a consent form in accordance with Ethical Committee of UNESP.

Study protocol

This clinical trial lasted 10 weeks and all parameters were evaluated at initial time and after 24 sessions of the aerobic exercise training (AET). Initially, the anthropometric and cardiovascular parameters were measured and volunteers were familiarized to the treadmill during 2–4 days, depending upon each participant. After familiarization, maximal lactate steady state (MLSS) was defined individually for prescription of AET intensity. Briefly, postmenopausal women performed two to five tests with fixed duration (30 min) and walking speed (5.5 km/h) on a treadmill (Movement RT 250 PRO) in accordance with previous study [14]. The inclination of the ergometer was used to control the intensity that ranged between 1 and 15%. The intensity was adjusted in each test according to the aerobic capacity of the participant. Measurement blood lactate concentration was performed at rest, 10th and 30th min during incremental test. MLSS was determined when the difference of blood lactate concentration between 10th and 30th min was not exceeded 1 mM [15].

AET program consisted of 24 sessions in treadmill, 3 times per week, duration of 30 up to 40 min for each session, for 8 weeks. The intensity of the AET was 100% of the MLSS according to previous incremental test. Heart rate was monitored and AET was supervised by exercise physiologists in an environmental with temperature ($\approx$25 °C) and humidity (40–60%) controlled. Figure 1 illustrates the experimental design.

Anthropometric parameters

Body weight and height was determined using a scale and stadiometer (Toledo 2096 PP). Body mass index was calculated as the ratio body weight divided by the square of the height in meters. Waist circumference was measured at the midpoint between the last rib and iliac crest.

Cardiovascular parameters

Blood pressure (BP) – After 20 min of sitting position, three consecutives BP measurements using a semi-automatic equipment (Microlife MIB-P3BTOA). Resting BP was determined as the average of the measurements.

Heart rate (HR) – HR was measured using a heart rate monitor (Polar FT1 TRQ) after 20 min of seated position. At the final of the resting period the value of HR was obtained.

Blood samples

Blood samples were collected after 12 h of overnight fast (between 7:00 and 8:00 am). Blood samples were collected from the antecubital vein using standard venipuncture methods. Samples were centrifuged (3000 rpm, 12 min) and the supernatant (plasma and serum) were stored in aliquots at −80 °C for future analysis.

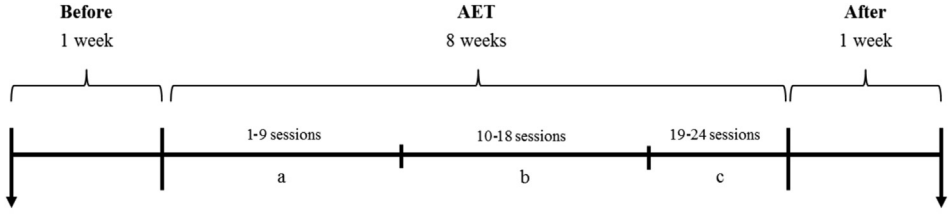

Figure 1. Experimental design.