34 - CARDIOVASCULAR EFFECTS PRODUCED BY AQUATIC EXERCISE IN ELDERLY NORMOTENSIVE AND HYPERTENSIVE SUBJECTS.

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INTRODUCTION

The arterial hypertension (AH) represents the leading cause of death worldwide, the AH increases cardiovascular risk developing clinical complications that include ventricular hypertrophy, ischemic heart disease, myocardial infarction, vascular disease and renal failure. The sedentary lifestyle, genetic and neurological and renal dysfunctions are associated with the development of hypertension (HUA et al., 2009).

Studies show that systolic and diastolic pressure decrease and baroreflex sensitivity increased in hypertensive subjects who practiced regular physical activity (HUA et al., 2009). Another study at long-term effect of regular exercise showed that, in groups of physically active hypertensive patients, there is less chance of developing hypertrophy of the ventricular mass, as regular physical activity prevents this type of hypertrophy (PALATINE et al., 2009).

In elderly hypertensives, the effects of exercise on blood pressure are shown as non-pharmacological effective treatment. The exercise in the aquatic environment has some advantages to any individual in particular the elderly, with the use of physical properties of water, enabling higher yields and lower risks offering, such as less likelihood of falling and low impact (ALVES, MOTA, and CUNHA ALVES, 2004).

The exercise performed in water produces physiological responses different from those found outside this environment, studies have shown that exercise performed in water suffer the effects of hydrostatic pressure, leading to a shift of extracellular fluid to the vascular spaces, producing an increase in central blood volume recognized as central hypervolemia (WATENPAUGH et al., 2000 and DERTKIGIL et al., 2005).

The redistribution of blood flow during immersion promotes a differentiated cardiovascular control either at rest or during exercise is observed higher values of cardiac output, decreased peripheral vascular volume and decreased heart rate (HR) (PARK et al., 1999). Regarding blood pressure response, the immersion induced an increase in systolic blood pressure (SAP) at rest when the body is immersed in normotensive (PARK et al., 1999). Due to changes that occur on the cardiovascular system during the immersion the objective of this study was to compare the cardiovascular responses produced by exercise in the aquatic and land in elderly hypertensive.

MATERIALS AND METHODOS

SUBJECTS

The subjects consisted of six normotensive women e7 hypertensive women with mean age 66 ± 6 years and 64 ± 4 years respectively. The subjects that use of beta blockers and patients with osteoarticular diseases of lower limbs and / or use of artificial joints in the legs were excluded from the study. The criterion used to determine the readiness for physical activity was through the PAR-Q questionnaire. All subjects had a height between 145 to 165 cm and practicing regular physical exercise for a minimum period of six months.

PROCEDURES

This study is characterized as a crossover, in which all volunteers were subjected to random (draw), all experimental conditions, they were their own controls. The subjects performed three visits to the laboratory. During the first visit were collected anthropometric measurements, body composition and oxygen consumption (VO2). The subjects performed two tests in a water environment and the other on land, on different days with 48 hours of interval. The exercises were conducted in and out of the water, and the exercise rhythm was determined by a metronome (ENO EMT 888), the cadence of execution was 70% of maximum heart rate. The subjects performed five exercises in sequence: Punch, skiing, lifting the knees, twist, and heel on the hip with his hands behind where the heel touched the hands, on land and water, lasting 2 minutes each. The pool used for the tests showed temperature 29 ± 2C °, and the water level remained at the xiphoid process.

Measurements of BP and HR were obtained at rest, in the sixth minute and the tenth minute of the test; these times were used based on data showing that 6 minutes of exercise can be a strong indicator of blood pressure response in normotensive and hypertensive subjects (KOKINOS et al., 1995). The HR was acquired through a heart monitor (Polar-FS1), BP was measured by auscultation method using a stethoscope and a sphygmomanometer, consisting of a blood pressure cuff and an aneroid pressure gauge (Certified). The individual has performed the exercises with a cuff on the left arm, during the BP measurement in the sixth minute the individual stopped performing the exercises for 30 seconds.

ETHICAL CARE

The present study was approved by the research ethics committee of the Centro Universitário de Belo Horizonte - Uni-BH with Protocol 097/98, also presented the anonymity and a consent form that all participants signed.

STATISTICAL ANALYSIS

The results were expressed as mean and plus or minus standard error of mean. We used analysis of variance ONE WAY ANOVA followed by Newman Keuls test, the level of significance was $p < 0.05$.

RESULTS AND DISCUSSION

The body weight of the sample was 66 ± 6 kg and 64 ± 4 kg, the fat percentage was 27 ± 2% and 30 ± 7%, and VO2 was 23 ± 1 ml / kg / min and 20 ± 4 ml / kg / min in normotensive and hypertensive group, respectively.

Table 1 shows the values in resting heart rate, systolic and diastolic pressures in the group of normotensive and hypertensive women in the land and water.

Table 1: Resting values in aquatic and land environment.

	HR bpm	SAP mmHg	DAP mmHg
Normotensive (land)	79±2.2	124±1.6	80±1.8
Hipertensive (land)	77±3.0	125±2.3	80±1.0
Normotensive (aquatic)	80 ±2.0	124±1.7	85±1.3*
Hipertensive (aquatic)	78±3.0	127±3.6	80±1.0

p< 0.006 in comparison with other groups.

Figure 1 shows the values of HR during exercise in the aquatic environment and land in normotensive and hypertensive groups. The HR was significantly lower during exercise in the aquatic environment as compared to the land environment in both hypertensive and normotensive group. At 6 ° and 10 ° minutes of exercise HR was higher in hypertensive group compared to normotensive in the aquatic environment, while on land at 10 minutes of exercise, the volunteers with hypertension had lower HR on land compared to normontensive group.

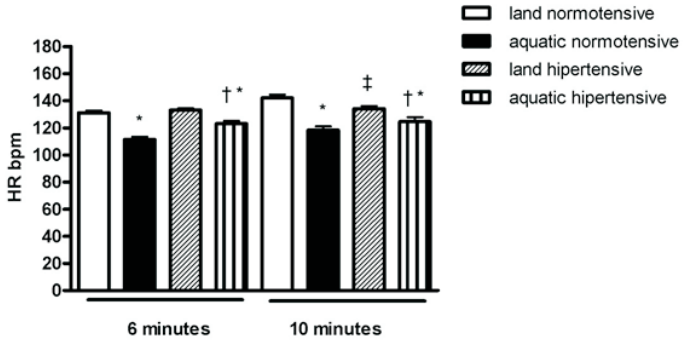

Figure 01: Values of heart rate (HR) at the 6 and 10 minute of exercise on aquatic and land environments in normotensive and hypertensive groups. * p <0.0001 compared to the land environment, † p <0.05 compared with the aquatic normotensive at 6 and 10 minutes, ‡ p <0.05 compared to land normotensive at 10 minutes of exercise.

Figure 2 shows the values of SAP during exercise, interestingly, the SAP of normotensive volunteers was the opposite of that observed for the hypertensives, while for the normotensive group there was reduction in SAP in the aquatic exercise, for the hypertensive was observed an increase, this result was observed at 6 and 10 minutes of exercise, in addition, the SAP during exercise performed on land was lower for the hypertensive group compared with normotensive.

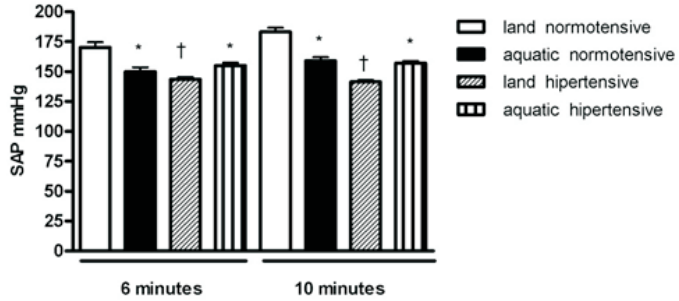

Figure 02: Values of systolic (SAP) at 6 and 10 minutes of exercise on aquatic and land environments in normotensive and hypertensive groups. * p <0.0001 compared to the land environment, † p <0.001 compared to normotensive land group.

The values of DAP were not different between the land and aquatic exercise or between groups (Figure 3).

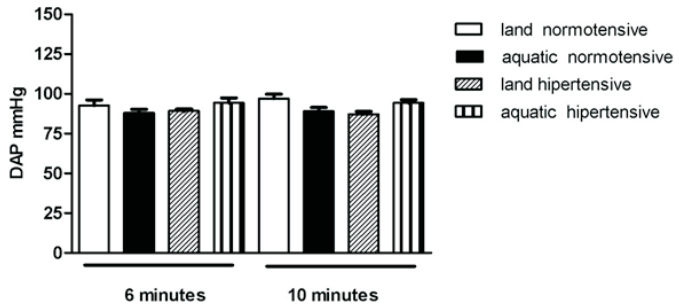

Figure 03: Values of diastolic blood pressure (DBP) at 6 and 10 minutes of exercise on aquatic and land exercise in normotensive and hypertensive groups

Figure 4 shows the values of double product (DP), was observed a significant reduction in the DP in the aquatic exercises for the normotensive group compared to the land environment. For hypertensive group was not observed significant differences between aquatic and land exercise.

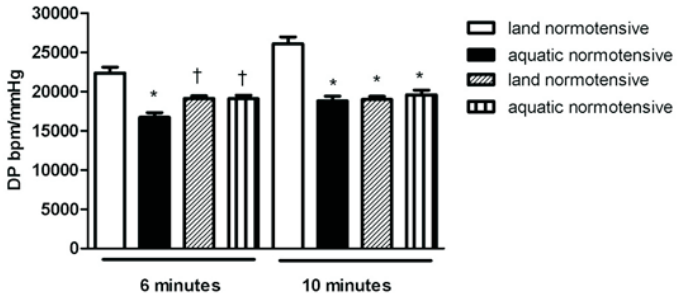

Figura04: Values of DP at 6 and 10 minutes of exercise on aquatic and land environments in normotensive and hypertensive groups. * p <0.0001 compared to land in the normotensive group, † p <0.001 compared to both land and aquatic group of normotensive to 6 minutes.

DISCUSSION

This study shows the effect of land and aquatic exercise on cardiovascular responses in elderly hypertensive. The data obtained in this study show that the resting HR was not different when compared aquatic and land enviroment both in normotensive and in hypertensive group, bradycardia during immersion is observed in other studies (Svedenhag et al. 1992, Denadai et al., 1997, Kruel et al., 2001, HEITHOLD et al., 2001) the results obtained in our study can be different of others because the time to acquire the resting values was only 5 minutes.

The HR response to exercise was lower in aquatic exercise compared with land for the normotensive and hypertensive, KRUEL et al. (2001), HEITHOLD and GLASS (2002), observed reduction in HR during shallow water exercise in healthy young and elderly. The decrease in heart rate during aquatic exercise can be attributed to central hypervolemia, which stimulate the cardiopulmonary receptors reducing sympathetic nerve activation (WATENPAUGH et al., 2000, Reilly et al., 2003 and DERTKIGIL et al., 2005), this work indicates that in hypertensive subjects the mechanism described above can also be regulating the response of HR to aquatic exercise.

An interesting finding in the present study was the behavior of SAP, while for the normotensive subjects there is a reduction in SAP during aquatic exercise, for the hypertensives has been a rise in SAP, in healthy young adults performing the exercise on cycle ergometer was observed an increase in SAP equivalent to that observed in the land (PARK et al., 1999). Two hours of immersion without exercise, SAP increase in healthy young (WATENPAUGH et al., 2000).

The reduction in SAP observed in the normotensive group can be attributed to the reduction in peripheral resistance which is observed during the immersion or during aquatic exercise (PARK et al., 1999), this reduction is by decreasing sympathetic activity (MANO et al., 1985) and catecholamine levels during immersion (Connelly et al., 1990), it is known that the condition of hypertension there is an increased in peripheral resistance (Finkielman et al., 1965) associated with this condition central hypervolemia produced by immersion may contribute to the increase in SAP in the hypertensive group.

With regard to the results found for DAP they agree with other data (PARK et al., 1999, WATENPAUGH et al., 2000) who observed in their studies that DAP remains unchanged during the exercise performed in water. The data obtained from the double product indicate a lower cardiac work for the normotensive group in the aquatic environment, the same result was not observed in the hypertensive group; this can be attributed to the increase in SAP observed in aquatic exercise in this group.

The data presented indicate that the cardiovascular response during aquatic exercise for elderly hypertensive is different from that seen in normotensive for SAP and DP, indicating that cardiovascular control during exercise may be influenced by pathology. These findings may contribute to the planning and control of aquatic training, but more studies are needed to identify the possible interference of hypertension on cardiovascular response during aquatic exercise.

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CARDIOVASCULAR EFFECTS PRODUCED BY AQUATIC EXERCISE IN ELDERLY NORMOTENSIVE AND HYPERTENSIVE SUBJECTS.

ABSTRACT

Water immersion produces changes on the cardiovascular system resulting from central hypervolemia which produces increased stroke volume and heart rate (HR) decrease. This study evaluates the effect of aquatic exercise on cardiovascular parameters in elderly normotensive and hypertensive. The study sample consisted of six normotensive and 7 hypertensive women. Beta blockers users and patients with osteoarticular diseases were excluded from the study. The subjects performed two tests with an interval of 48 hours in and out of water for 10 minutes with the water at the xiphoid process. The voluntaries performed the test at an intensity of 70% of maximum HR set by a metronome. The HR and blood pressure (BP) values were collected using a heart monitor and a device for manual BP at rest, in the sixth and tenth minute during the test. The heart rate values in water were significantly lower in the sixth and tenth minutes (111 ± 2.0 ± 2.7 bpm bpm/118 normotensive), (123 ± 2.0 ± 3.2 bpm bpm/124 hypertensive) compared with the land environment (131 ± 1.6 ± 2.3 bpm bpm/142 normotensive), (143 ± 1.7 ± 1.9 bpm bpm/134 hypertension) both for the normotensive and hypertensive group. The systolic blood pressure (SAP) values were lower in the normotensive group in the aquatic environment (150 ± 3.6 ± 3.0 mmHg mmHg/159) compared with the land (170 ± 4.1 mmHg / 183 ± 3, 3 mmHg) while for the hypertensive group the SAP values were higher in the aquatic environment (155 ± 2.4 mmHg / 157 mmHg ± 1.8 water) (143 ± 1.7 mmHg / 141 ± 1.4 mmHg land). This study show that a significant reduction of the heart rate in the aquatic environment in hypertensive subjects, in addition, the present data show that SAP has a differential control during aquatic exercise in elderly hypertensive.

KEYWORDS: immersion, blood pressure and heart rate.

EFEITOS CARDIOVASCULARES PRODUZIDOS PELA EXECUÇÃO DE EXERCÍCIOS EM MEIO AQUÁTICO E TERRESTRE EM IDOSAS NORMOTENSAS E HIPERTENSAS

RESUMO

A imersão no meio líquido produz alterações sobre o sistema cardiovascular conseqüentes da hipervolemia central a qual produz aumento volume sistólico e diminuição da freqüência cardíaca. Foi avaliado o efeito do exercício físico aquático sobre parâmetros cardiovasculares em idosas normotensas e hipertensas. A amostra do estudo foi composta por 6 mulheres normotensas e7 hipertensas. Foram excluídas do estudo, aquelas que faziam o uso de beta bloqueador e portadores de doenças osteoarticulares. Os indivíduos executaram dois testes com intervalo de 48 horas dentro e fora da água durante 10 minutos com a água na altura do processo xifóide. Realizaram o teste em uma intensidade de 70% da freqüência cardíaca máxima definida através de um metrônomo. Os valores de freqüência cardíaca (FC) e pressão arterial (PA) foram coletados através de um monitor cardíaco e um aparelho de pressão arterial manual durante o repouso, no sexto e no décimo minuto durante o teste. Os valores de FC dentro da água foram significativamente menores ao sexto e décimo minuto de exercício (111±2,0 bpm/118 ± 2,7 bpm normotensa), (123±2,0bpm/124 ± 3,2 bpm hipertensa) em comparação com o ambiente terrestre (131±1,6bpm/142 ± 2,3 bpm normotensa), (143±1,7bpm/134 ± 1,9 bpm hipertensa) tanto para o grupo normotenso como hipertenso. Os valores de pressão arterial sistólica (PAS) foram menores para o grupo normotenso no meio aquático (150±3,6 mmHg/159 ± 3,0 mmHg) em comparação com o terrestre (170±4,1 mmHg /183 ± 3,3 mmHg) enquanto que para o grupo hipertenso os valores da PAS foram maiores no meio aquático (155±2,4 mmHg /157 ± 1,8 mmHg aquático) (143±1,7 mmHg /141 ± 1,4 mmHg terrestre). O presente estudo mostrou que a freqüência cardíaca sofre uma redução significativa no ambiente aquático em sujeitos hipertensos, além disso, os dados apresentados mostram que a PAS possui um controle diferenciado durante a realização do exercício aquático em idosas hipertensas.

PALAVRAS-CHAVE: imersão, pressão arterial e freqüência cardíaca.