35 - AEROBIC EXERCISE IN CORONARY HEART DISEASE: BIOMOLECULAR FUNCTIONAL ASPECTS

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INTRODUCTION

Coronary artery disease (CAD) is characterized by the gradual narrowing of the coronary vessel light that causes insufficient supply of oxygen and nutrients to cells of the myocardium which generates a cascade of events augmented by inflammatory agents.

The Brazil is an emerging country, and similar to developed world countries, has a high incidence of deaths caused by cardiovascular diseases. According to the IBGE, in the year 2002, registered a mortality rate of 28.8% of men and women 36.9% (pine et al., 2010).

There are several risk factors are known for literature, among them include the sedentary lifestyle, smoking, obesity, diabetes mellitus, hypertension, hypercholesterolemia and family history.

The predominant factor for the progression of atherosclerosis in the coronary arteries are arising from the change of vascular biology that includes reducing the bioavailability of nitric oxide (NO), increased formation of reactive agents and increased endothelial activity (pine et al., 2010).

Aerobic exercise is a non-pharmacological intervention that allows with or without interaction with drugs to reduce the stenosis of the coronary arteries, reducing the deleterious effects of the disease, in order to enable the greater survival of patients affected by this pathology.

Coronary circulation: Functionality, Distribution and flow Control

Coronary circulation, epicardic arteries have a decisive role in the resistance of intramyocardial pressure portion and arterioles and the targeting of the myocardial flow to different areas of the myocardium (CESAR & FERREIRA, 2004).

The blood vessels, so in general, are predisposed to various hemodynamic forces acting as cyclic strain and hydrostatic pressure, fluid shear. The magnitude of the shear strength can be determined as a directly proportional relationship blood viscosity and inversely proportional to the third power of the radius area of the vessel (CHIU & CHEIN, 2011).

According to the principles of hydrodynamics, the fluids are substances that are unable to maintain their shape in your interaction with a shear force. The viscosity generates resistance to flow to form concentric layers that limit the mixture of elements between the layers providing flow laminarity. When the radius of the tube increases, the flow is laminar and turbulent becomes in which there is an increase of dissipated energy in the system and formation of lateral waves (OLIVEIRA ET AL., 2010).

Control of coronary flow is modified dynamically through the metabolic demand imposed by myocardial activity. These adjustments are promoted through adaptive mechanisms: metabolic control, reflex miogenic, endothelial factors and neurohumoral activation (CESENA & CHAGAS, 2001).

Exercise plays a key role in hemodynamic and Autonomic adjustments on coronary circulation, as well as the entire cardiovascular system, because the adjustments for maintaining cellular homeostasis in response to metabolic demand promote progressively the increase in cardiac output, redistribution of blood flow and the elevation of circulatory perfusion for all muscles involved in the activity (MONTEIRO & SOBRAL, 2004).

The regular practice of aerobic training, long-term, may contribute to hydrodynamic changes in blood flow promoted by beneficial effects the endothelium-dependent vasodilation in which there is the modulation of increased protein expression in synthase contributing to the increased strength of shear and, culminating to a laminar flow (NIEBAUER & COOKE, 1996).

The endothelial cells and the regulation of hemostasis

The endothelial cells are units of regulation of hemostasis, therefore they possess activities and antithrombotics and prothrombotics so that there is the establishment of a relationship of balance. Endothelial cells have antiplatelety functions, anticoagulants and fibrinolytics. When his injury or activation promotes procoagulants activities. This action can be induced by infectious agents, hemodynamic forces, mediators and cytokines plasma (ROBBINS & CONTRAN, 2010).

Nitric oxide (NO) is a gaseous molecule and a free radical unpaired electron which presents a last layer and a half-life of 4 to 8 seconds in aqueous medium oxygenated and participates in many biological processes, signaling being produced in the endothelium and is a protagonist in vasodilation, inhibition and platelet aggregation. Therefore, the bioavailability of the is a determining factor for systemic order and endothelial function in coronary arteries (VANNI ET AL., 2007).

The functional performance of nitric oxide is based on performance in various physiological processes as neurotransmission, blood pressure control, blood clotting blood and immune system, player participation and in the process of hemostasis (VANNI ET AL, 2007) (QUEIROZ .1999).

In the literature, there are several works that describe the effect of physical exercise on endothelial cells, mainly regarding the increase of the shear stress at which there is an increase in the release of vasodilators factors by the vascular endothelium, as in, the endothelium-derived hiperpolarizant factor (EDHF), culminating with the reduction in systemic arterial pressure (ZAGO & ZANESCO, 2006).

Coronary Artery Disease

Coronary artery disease (CAD) occurs by gradual narrowing of the arteries (stenosis) that supply the heart muscle by a thickening of the inner layer resulting in atherosclerosis (POWERS; HOWLEY, 2009). With this, there is an imbalance between the demand and the supply of oxygen in which may result in myocardial infarction and stroke which can be generate sudden death.

In 1948, the United States, we conducted a prospective epidemologic study, the Framingham Study, with the objective of detecting the cause-and-effect relationship for the development of coronary heart disease in which reached 50% of the

numbers of deaths in that country (FRAMINGHAM, 2011). This study has enabled great advances in planning of prevention and treatment, since it was possible to detect the primary and secondary risk factors which meant that there was growth in the development of the disease.

Epidemologics recent research data show that atherosclerosis is a chronic inflammatory disease and multifactorial and its risk factors: Hypertension , smoking, the dyslipidemias (largest percentage prevalence of LDL into HDL ratio), Diabetes Mellitus (DM), family history, obesity (greater predominance of waist about waist-hip ratio), sedentary, diets high in saturated fats, age (highest incidence in elderly IDEs) , gender (women in the climacteric and post-menopausal period), high levels of homocysteine, hyperinsulinemia, hypothyroidism (increase in LDL), liver diseases, chronic carriers of AIDS and chronic kidney disease (PUBLIC HEALTH .2011).

Powell et al. (1987) physical inactivity presents itself as an independent factor in the development of coronary heart disease, when is parsed to their correlation with other factors such as: hypertension, hypercholesterolemia and smoking (POWERS; HOWLEY, 2009). These authors, pointed to the sedentary as a factor that predated the coronary heart disease over the years, as well as, the higher was the level of physical activity, the lower the risk of coronary heart disease.

Aerobic exercise in coronary artery disease

Aerobic exercise is a category of physical exercise that involves large muscle groups in dynamic activities that result in the substantial increase in the heart rate and energy expenditure. Regular participation results in benefits to the cardiovascular and musculoskeletal system function, optimizing the increase in performance of endurance (HOWLEY, 2001).

Physical training carried out on a regular basis promotes improvement in endothelial function, physical capacity and the emergence of collateral vessels in patients with CHD, including improvement of body weight, blood pressure, insulin sensitivity, inflammatory and haemostatic variables (TEODORO ET AL., 2010).

The main benefits that aerobic training promotes of which treat – the lowering of blood pressure and inhibition of aterogenic that are mediated by changes in vascular biology through molecular mechanisms (KOJDA & HAMBRECHT, 2005).Several studies show that physical training promotes the improvement of myocardial perfusion by restoring endothelial function, the microcirculation, the regression of coronary atherosclerotic lesions, increased collateral circulation, reduce blood viscosity and the increased diastolic perfusion time (NEGRÃO & BARRETO, 2010).

The Brazilian society of Cardiology (BSC), recommends the regular practice of aerobic exercise in a weekly frequency from three to six times, lasting 30 to 60 minutes per session and at moderate intensity (60 to 70% of maximum heart rate) for the prevention and treatment of atherosclerosis and Dyslipidemia (HOWLEY, 2001), (SBC, 2007).

The parameters used for planning cardiac rehabilitation Programs as the aerobic training of patients with CHD is fundamental to promoting the benefits and to perform the activity safely in supervised groups. Therefore, the present study aims to identify the main effects of physical exercise on biomolecular parameters and functional change of patients with coronary artery disease.

Were made to the database queries of Medline (PubMed), Scielo and periodicals in the area of Cardiology (AHA and BSC) using the keywords atherosclerosis, aerobic exercise, coronary artery disease and their translations into English, the past 15 years (1997-2012). Articles were selected to highlight functional adaptations and at the molecular level through the practice of aerobic exercise using different parameters. In the analysis, we selected 8 articles, because they treated if of original unpublished work with patients with coronary artery disease and subjected to ethics committees.

RESULTS AND DISCUSSION

Selected studies have identified the physiological adaptations with regard to cardiovascular function, pointed out important directions as aerobic exercise prescription to patients with CAD.

In the study of NIEWLAND ET AL. (2000), were reported better results in the group which held sessions of exercises with a greater frequency in terms of increased ventilatory anaerobic threshold. Therefore, this group reduced fatigue progressively for the practice of exercises, and probably to carry out their daily activities, providing a better quality of life. There were similar results between the two groups regarding the increase in peak VO2 and aerobic power. With that, you can consider that the frequency of training is critical for increasing tolerance to fatigue, but it is not a variable that determines the improvement of peak VO2 and aerobic power in a program of 2 months.

According to findings of BELARDINELLI ET AL. (2001), there is a big difference on clinical prognosis of patients who underwent coronary angioplasty (PTCA) or coronary stent (CS) and they have done subsequently, an exercise program and of patients who are sedentary. In six months, patients obtained improvement in hemodynamic and increased values ≥ 1 MET and the VO2 peak obtained an increase of 26%, while the control group, there was a reduction of this variable. Were reported improvement in quality of life to carry out the daily activities in the exercise group.

Other important results were the smallest increase of restenose by the group trained, but was not significantly statistician, however, the residual stenosis diameter was lower in the group of patients trained with 29.7%, lower rate of hospital readmissions and event rate than the control group. With that, you can consider that the aerobic exercise clinical treatment allows the reconciled cost savings generated in hospital readmissions and promotes good results after invasive procedures for the CAD.

On intervention of MOHOLDT et al (2009), the strategy established in aerobic interval training was to provide with increased intensity greater acquisition as VO2 peak and training and rest FC, quality of life, increased adiponectin and reduction of ferritin (coronary disease marker). The correct water aerobic exercises were carried out with active rest with the reduction of the intensity of 90% to 70% of Max HR, in the period of 4 weeks was an initial assessment and patients were reassessed after 6 months. Both groups showed similar results of increase in VO2 peak and adaptations in CF training and rest in the period of 4 weeks. In 6 months of training, aerobic interval group obtained significant difference compared to moderate aerobic. Aerobic interval training with a similar response regarding continuous aerobic conditioning in the short term, and the interval training exceeds the continuous physiological adaptations as the long term.

As for participation in supervised groups and not supervised, CHUL KIM ET AL. (2011) reported that the supervised group improved on the maximal oxygen consumption, maximum heart rate, resting heart rate and the double product. The unsupervised Group had significant improvement in oxygen consumption of oxygen and double product. However, the supervised group acquire best results in relation to the other group. With professional tracking enabled, there is a greater training optimization by necessary interventions at every session. But, it should be emphasised that the practice in supervised groups is an important option to the CAD group reduce their risk of disease progression.

Among the benefits of aerobic exercise on the cardiovascular system biomolecular level, highlights the beneficial changes in the profile lipidic, in which it was evaluated in the study of ZIEGLER ET AL. (2006) and no reduction was obtained of the lipid profile and oxidized LDL, however were found increased resistance to oxidation. One of the limitations of this study,

refers to the short duration of the study and the time of the exercise session. Other studies, in which the parameter of longer lifespans and increase in frequency for 3 times a week would bring significant contributions in the lipid profile.

High intensity aerobic exercise can promote the release of inflammatory factors in a single session, according to DANZIG ET AL (2009), CAD and healthy patients who performed aerobic exercise so vigorously had an elevation of MMP-9 and BNP. The MMP-9 belongs to family of endopeptidases that participates in the degradation of collagen, elastin, fibronectin and other molecules associated with the progression of the atherosclerotic plaques and rupture.

The BNP is a sensitive marker of left or right ventricular overload, being a marker used for the diagnosis of congestive heart failure and stratification of patients with pulmonary embolism. In this way, healthy individuals or patients with CAD, wants to perform high intensity workouts and get exposed to this intensity for excessive time, may suffer risks by increasing the release of inflammatory substances in the systemic circulation or overload the heart operation, being that intensity against indicated. With this study, it is necessary to point to the harmful damage of a vigorous and continuous intensity on formation of substrates that cause oxidative stress.The recommendation for individuals with Atherosclerotic involvement is to avoid carrying out vigorous intensity activity, because these may increase the risk of release of inflammatory substances and platelet aggregation .

According to the data of HAMBRECHT ET AL (2000), the aerobic workouts provide many benefits to endothelial function for patients CAD, by the fact that the improvement in endothelium-dependent vasodilation in the vessels and epicárdicos of resistance in these patients. After 4 weeks of physical training, there were changes in blood flow in the coronary arteries in response to administration of acetylcholine in dose dependent. In this way, the physical exercise attenuates the coronary vasoconstriction in response to acetylcholine contributed to improvement of the flow of conductive epicardy arteries.

In another study with patients CAD, HAMBRECHT ET AL. (2003) concluded that physical training improves endothelium-dependent vasodilation mediated by agonist in mammary arteries in patients with CAD. This result is accompanied by an increase of eNOS protein expression and more specifically Akt-dependent on the phosphorylation of eNOS in Ser1177. The state of phosphorylation of eNOS in Ser1177 correlates with improved endothelial function in vivo. This study revealed an important finding about the influence of physical exercise on changes of protein expression and its contribution to adjusting functional agents failed left ventricle and the bioavailability of the.

In General, parameters used and who demonstrated physiological benefits in the studies analysed were a frequency of variation between 2 to 5 weekly sessions, with session duration of 10 minutes to 40 minutes of aerobic exercise in a target zone with moderate to severe intensity. In all the studies, participants were advised to start with preheating and near the end of the session reduced the speed gradually. Exercise sessions described ranged in their methodology can carry out continuous training or fractionated. It is necessary to point out that some studies have evaluated the patients ' quality of life in what is an important factor to generate motivation for patients with CAD to participate in exercise programs.

CONCLUSION

Aerobic exercise is a non-pharmacological strategy and essential to the treatment of patients with coronary artery disease. Several studies have shown the benefits functional biomolecular that activity in practice and, however it is required to conduct further studies to clarify other mechanisms inserted on this therapeutic intervention.

Some protocols that induce the practice of aerobic training at high intensities must be measured, not only at the level of functional benefits, but also through evaluation of biomolecular markers, so that the training can be safe and there's no way to increase cardiovascular risk.

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EFFECTS OF AEROBIC EXERCISE ON CORONARY HEART DISEASE: BIOMOLECULAR FUNCTIONAL ASPECTS

ABSTRACT

Coronary artery disease is a pathology that causes abnormalities of the coronary arteries, which causes more prevalent is the atherosclerotic process. The formation of atherosclerosis changes the compliance of coronary vessels and their hemodynamics in which culminates with the disorder in coronary flow control. Myocardial ischemia raises limitations to patients and decreased myocardial perfusion, in a manner that promotes the reduction of daily activities. The objective of this study was to identify the main effects of aerobic exercise on Biomolecular and funcional parameters change of patients with coronary artery disease. Were made to the database queries of Pub Med, Scielo and periodicals in the area of Cardiology (AHA and SBC) using the keywords atherosclerosis, aerobic exercise, coronary artery disease and their translations into English, the past 15 years (1997-2012). One of the main functional adaptations include the increase in peak VO2, increased ventilatory threshold anaerobic, maximum heart rate and resting heart rate; Biomolecular adaptations are bound to lipid profile and bioavailability nitric oxide. The aerobic exercise is a therapeutic intervention and pharmacological not that contributes to improving the health status of patients with Coronary artery disease through adjustments in biomolecular and functional levels.

KEYWORDS: Coronary Artery Disease; Aerobic Physical Exercise; Atherosclerosis.

EFFETS DE L'EXERCICE AÉROBIE SUR LA MALADIE CORONARIENNE : BIOMOLÉCULAIRE ASPECTS FONCTIONNELS

RÉSUMÉ

Coronarienne maladie est une pathologie qui entraîne des anomalies des artères coronaires, ce qui provoque le plus répandu est le processus de l'athérosclérose. Change la conformité de la formation de l'athérosclérose des vaisseaux coronaires et leur hémodynamique simulateur dans lequel culmine avec le désordre dans le contrôle du débit coronarien. Ischémie myocardique pose des limites aux patients et une diminution de la perfusion myocardique, d'une manière qui favorise la réduction des activités quotidiennes. L'objectif de cette étude était d'identifier les principaux effets de l'exercice aérobie sur biomoléculaire fonctionnelle et paramètres changent des patients atteints de maladie coronarienne. Ont été faits pour les requêtes de base de données de Pub Med, Scielo et périodiques dans le domaine de la cardiologie (AHA et SBC) à l'aide de l'athérosclérose des mots-clés, des exercices aérobiques, maladie coronarienne et leurs traductions en anglais, au cours des 15 dernières années (1997-2012). Une des principales adaptations fonctionnelles comprennent l'augmentation des PIC VO2, une augmentation du seuil ventilatoire anaérobie, la fréquence cardiaque maximale et rythme cardiaque au repos ; Biomoléculaire adaptations sont liées à la biodisponibilité de profil et de l'oxyde nitrique lipidique. L'exercice aérobie est une intervention thérapeutique et pharmacologique n'est pas que développer pour améliorer l'état de santé des patients atteints de maladie coronarienne grâce à des ajustements en biomoléculaire et niveaux fonctionnels.

MOTS-CLÉS: La maladie coronarienne; Exercice physique aérobie ; Athérosclérose.

EFECTOS DEL EJERCICIO AERÓBICO EN LA ENFERMEDAD CARDÍACA CORONARIA: BIOMOLECULAR ASPECTOS FUNCIONALES

RESUMEN

Enfermedad de la arteria coronaria es una patología que causa anormalidades de las arterias coronarias, que causa más frecuente es el proceso aterosclerótico. La formación de aterosclerosis cambia el cumplimiento de los vasos coronarios y su hemodinámica en la cual culmina con el desorden en el control de flujo coronario. Isquemia miocárdica plantea limitaciones a los pacientes y disminución de la perfusión miocárdica, de manera que promueve la reducción de las actividades diarias. El objetivo de este estudio fue identificar los principales efectos del ejercicio aeróbico en parámetros Biomolecular y cambio funcional de los pacientes con enfermedad arterial coronaria. Se realizaron a las consultas de base de datos de Medline (PubMed), Scielo y publicaciones periódicas en el área de Cardiología (AHA y SBC) usando la palabras clave ateroesclerosis, ejercicio aeróbico, enfermedad arterial coronaria y sus traducciones al inglés, los últimos 15 años (1997-2012).Una de las adaptaciones funcionales principales incluyen el aumento de VO2, mayor umbral ventilatorio anaerobias, máxima frecuencia cardíaca y frecuencia cardíaca en reposo; Biomolecular adaptaciones están obligadas a perfil lipídico y biodisponibilidad en el ejercicio aeróbico es una intervención terapéutica no farmacológica que contribuye a mejorar el estado de salud de los pacientes con enfermedad arterial coronaria a través de ajustes en los niveles funcionales y biomoleculares.

PALABRAS CLAVES: Coronariopatía; Ejercicio físico aeróbico; Ateroesclerosis.

EFEITOS DO EXERCÍCIO AERÓBICO NA DOENÇA CORONARIANA: ASPECTOS BIOMOLECULARES E FUNCIONAIS

RESUMO

A Doença Arterial Coronariana é uma patologia que causa anormalidade das artérias coronárias, sendo que a causa mais prevalente é a o processo aterosclerótico. A formação da aterosclerose altera a conformidade dos vasos coronários e a sua hemodinâmica no qual culmina com o distúrbio no controle do fluxo coronário. A isquemia miocárdica gera limitações aos pacientes e a diminuição da perfusão miocárdica, de maneira que promove a redução das atividades cotidianas. O objetivo deste estudo foi identificar os principais efeitos do exercício aeróbico na alteração de parâmetros biomoleculares e funcionais de pacientes portadores de doença arterial coronariana. Foram feitas consultas à base de dados do Medline (PubMed), Scielo e periódicos da área de Cardiologia (AHA e SBC), utilizando-se as palavras-chaves aterosclerose, exercício aeróbico, doença arterial coronariana e suas respectivas traduções para o inglês, dos últimos 15 anos (1997-2012). Dentre as principais adaptações funcionais destacam-se o aumento do VO2 de pico, aumento do limiar ventilatório anaeróbico, Frequência Cardíaca Máxima e Frequência Cardíaca de Repouso; as adaptações biomoleculares são vinculadas ao perfil lipídico e a biodisponibilidade do NO. O exercício físico aeróbico é uma intervenção terapêutica e não farmacológica que contribui para melhoria do estado de saúde de pacientes com Doença Arterial Coronariana através de adaptações em níveis funcionais e biomoleculares.

PALAVRAS-CHAVE: Doença Arterial Coronariana; Exercicio Físico Aeróbico; Aterosclerose.