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Impact of exercise training on Cardiovascular Disease and Risk

The highlights in a publication by Volker Adams and Axel Linke titled “Impact of exercise training on cardiovascular disease and risk”, are physical fitness is associated with reduced cardiovascular mortality, exercise training in congestive heart failure can reduce mortality and increases quality of life, training compliance is a critical factor for achieving the exercise-mediated benefits, and exercise training affects the vascular system the skeletal muscle and the myocardium (Adams & Linke 2019). Their article is outlined into sections that go as followed, highlights, abstract, keywords, impact of exercise training on mortality, high inborn fitness–is it protective?, vascular effects of exercise training in cardiovascular disease, nitric oxide system (NO-ROS balance), regulation by microRNA, muscular effects of exercise, inflammation, catabolic/anabolic balance, energy metabolism, fiber type composition, myocardial effects of exercise, future directions, and conclusions.

Epidemiological studies support the idea that physical fitness is connected with reduced cardiovascular mortality and hospitalization due to cardiovascular disease. During the last two decades the idea of resting after a myocardial infarction has drastically changed and these days patients are mobilized and incorporated into exercise training programs very soon after the insult. Unfortunately, these beneficial effects of exercise training are independent of the genetic background and are only noted in case the exercise training program is not paused for a longer time. Therefore, to really take advantage of the effects of exercise training in health care the

obstacle for the future is to increase exercise compliance by offering interesting and adequate exercise training programs. At the physiological and molecular level, exercise training affects numerous systems like the skeletal system and the vascular system. Changes obtained by regular exercise training span in the vascular system from increasing vasodilation due to an increase of bioavailable nitric oxide to a shift in catabolic/ anabolic balance in the peripheral skeletal muscle. In this publication the healthy benefit of exercise training and the molecular changes triggered by exercise training in the setting of secondary prevention are discussed (Adams & Linke 2019).

In the publications section on "Vascular effects on exercise training and cardiovascular disease", they discuss how the vascaular system is incredibly impaired in those who have heart failure. They also go on to say that studies have shown that exercise training has been used as a therapeutic intervention and proven to be beneficial for the vascular system by boosting endothelial function and reduced stiffness of vessels. They then go on to say that since there is a relationship between fitness and mortality the question comes up on if an inborn fitness may protect from disease development. A study was started by Koch and Brittin in 1996, they selectively breed rat only differing in inborn aerobic treadmill running capacity. After 11 generations the rats that had been breed with low aerobic fitness had developed features of the metabolic syndrome and the cardiomyocytes which are resembled features observed earlier in heart failure. Additionally the life expectancy was higher for the animals with the higher running capacity. Exercise intolerance is the main symptom imparing the quality of life for heart failure patients, resulting not only to dyspnoe, but also to harsh skeletal weakness observed in the limn and respiratory muscle. Intriguingly alterations in the peripheral skeletal muscle are a main predictor for exercise intolerance. Throughout the last several years molecular alterations could

be identified responsible for the development of muscular atrophy and dysfunction. Inflammatory factors are highly upregulated during the development of heart failure when compared to healthy controls. The prototype of inflammatory cytokines elevated in heart failure is tumor necrosis factor alpha. Other inflammatory cytokines like interleukin-6 and interleukin-1B are increased in heart failure patients with preserved or reduced ejection fraction. Skeletal muscle atrophy is a hallmark for patients with end stage chronic heart failure. In the literature several pathways responsible for degradation of muscle mass are reported with the activation of the ubiquitin proteasome system (UPS) being the best characterized one. Myostatin is secreted and produced by myocytes and influences muscle mass negatively by modulating muscle growth and differentiation.

Heart failure is associated with an increased energy demand and decreased energy metabolism, which results in an energetic imbalance. Skeletal muscle tissue that was analyzed from animal models with heart failure or human heart failure patients revealed an alterted expresson of the cytosolic and mitochondrial creatine kinase. A shift in fiber type composition is regularly observed in skeletal muscle biopsies collected from heart failure patients when compared to healthy patients. An increase in less aerobic type II and decrease in aerobic type I fibers are documented. Also, recently in those with heart failure and preserved ejection fraction, the percentage of type I fibers, type I-to-type II fiber ratio, and capillary-to-fiber ratio decreased, whereas the percentage of type II fibers increased. Participating in routine exercise training resulted in a reversal of the changes observed in fiber type composition and the decreased capillary-to-fiber in heart failure.

Increasing adheres to exercise training recommendations to transmit benefits of exercise training to the patients enrolled in programs is one of the biggest challenges. The heart failure

action trail is one of the most important factors for increasing exercise capacity and reducing mortality. Due to epidemiological observations it is fair to conclude that an active life style is associated with a decreased risk to develop cardiovascular disease. The benefits from exercise are only evident if physical activity is maintained throughout life. Unfortunately, genetics have a low impact on exercise-induced benefits. Therefore, the challenge for the future is to increase exercise training compliance by offering better programs to maintain physical fitness. At the molecular level several organs ranging from the skeletal muscle to vascular system are modulated by active exercise training.

References

Author links open overlay panelVolker Adams, Highlights•Physical fitness is associated with reduced cardiovascular mortality.•Exercise training in CHF can reduced mortality increases quality of life.•Training compliance is a critical factor for achieving the exercise-mediated benefits.•Exercise trai, & AbstractEpidemiological studies in large cohorts support the notion that physical fitness is associated with reduced cardiovascular mortality and hospitalization due to cardiovascular disease. During the last 20 years even the concept of resting inactive . (2018, August 28). *Impact of exercise training on cardiovascular disease and risk*. Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease. https://www.sciencedirect.com/science/article/pii/S0925443918303041?via%3Dihub#bb0135