Strength Training as an Adjunct to the Maintenance of Muscle Mass in Patients with Head and Neck Cancer

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Abstract: Head and neck cancer (HNC) is one of the most common types of the disease, particularly among men, and is characterized by a high incidence of death. Among the non-pharmacological factors that help in survival and improving quality of life is physical exercise, especially strength training. The purpose of this short communication was to briefly review the literature and present a training proposal for oncology patients with HNC. Evidence is provided that physical exercise, mainly short-term strength (HIIT [High-Intensity Interval Training]) and aerobic training, contributes to increased expectation and quality of life in cancer survivors. After reviewing the current state of literature, we conclude that strength training, by providing maintenance of muscle mass, improves the autonomy and quality of life of oncology patients with HNC.

Keywords: Cancer, exercise, strength training, health.

INTRODUCTION

Head and neck cancer (HNC), which covers the mouth, larynx and other sites associated with this region, has a high incidence among men, is the ninth most diagnosed type of cancer in the world and has high mortality rates [1]. Risk factors for HNC include: smoking, chewing of Areca nuts, excessive intake of any type of alcoholic drink, excessive exposure to ultraviolet radiation, and having been infected with the papilloma virus [1]. In addition, Gupta *et al*. [1] reported that individuals who eat diets low in antioxidant foods are more susceptible to environmental agents for the development of this type of cancer.

The oncological patient undergoing treatment has decreased autonomy due to reduced strength levels, which is closely associated with accelerated loss of muscle mass (cachexia), and progressive reduction in cardiorespiratory fitness. These changes promote a decrease in the perception of quality of life as well as increased morbimortality in this population [2]. To minimize such deleterious effects, recent studies propose that oncological patients perform physical exercises, even under chemo and radiotherapeutic treatments, with the aim of improving both functional capacity and quality of life [3,4].

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Regular exercise has been promoted among cancer patients, as it induces physiological and psychological benefits. In this sense, Lonkvist *et al*. [5], Sandmael *et al*. [6] and van Nieuwenhuizen *et al*. [7] found that training prevented muscle mass loss during and after treatment with chemotherapy and radiotherapy, as well as improved quality of life in patients with HNC. Thus, the present short communication has proposed to briefly review the literature and present a model of safe and effective training for patients with HNC.

CANCER AND CACHEXIA

Cachexia is characterized by accelerated loss of lean mass, with or without reduced body fat, leading to both a gradual decrease in functional capacity [8] and the increase in morbidity and mortality [9]. In addition, Meriggi [10] defined cachexia as body weight loss greater than 5% over the last six months in the absence of fasting or the combination of continuous body weight loss higher than 2% with BMI <20 kg/m².

Among the processes involved in cachexia, changes in metabolic pathways, apoptosis, and regeneration of muscle tissue are highlighted, and these processes are related to low-grade systemic inflammation [11]. The understanding of these pathways favors a better targeting of the alimentary routine as well as training, and engaging in exercise is an important mitigating agent of the deleterious effects of cachexia in cancer through several mechanisms, including modulation of muscle metabolism, improved

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insulin sensitivity and decreased production and secretion of pro-inflammatory cytokines [12].

AEROBIC TRAINING AND CANCER

Aerobic training is directly related to the increase in mitochondrial biogenesis and favors the improvement of cardiorespiratory capacity, but there are reports that a large volume of training (for example, 50-60 minutes per day) [13] negatively signals the mTOR pathway (protein synthesis) as well as stimulates the ubiquitin-proteasome pathway and the lysosomal autophagy system [14], which may accelerate cachexia in oncology patients. In this sense, the prescription and orientation of aerobic training for cancer patients should be carried out with caution, as in many cases the disease itself and/or treatments favor the occurrence of exacerbated proteolysis.

STRENGTH TRAINING AND CANCER

Taking into consideration the recurrent loss of muscle mass among cancer patients, strength training becomes one of the main adjuvants in the maintenance and/or increase of muscle mass, given the innumerable pathways for protein synthesis, among them the interaction between mechanical growth factor, stem cells, immune system, inhibition of myostatin, and the endocrine system [15]. All of these pathways act via the mTOR signaling pathway and inhibit the AMP-activated protein kinase and ubiquitin-proteasome pathways [14].

In an interesting study recently published by Gundersen *et al*. [16], it was found that strength training increased the number of stem cells, which can remain on standby for a period of 15 years or more. By extrapolating these findings to cancer patients who are physically active prior to the discovery of the disease, we may suggest that the recovery of muscle mass eventually reduced as a result of treatments could be accelerated due to "muscle memory" provided by prior and/or late training. In this sense, it is plausible to propose that cancer patients perform strength training to minimize the loss of muscle fibers.

COMBINED EXERCISE AND CANCER

Combined training (aerobic training + strength training) favors increased muscle mass, maintained healthy percentage of fat, and increased cardiorespiratory capacity [13]. However, the distribution of weekly training frequency, intensity, volume and rest periods is of the utmost importance when considering beneficial outcomes for oncology patients with HNC, since the deleterious changes caused by treatment can be worsened by the implementation of poor physical training programs that are improperly conducted.

Murach and Bagley [17] suggest that for combined training to promote muscle hypertrophy, the interval between aerobic and strength training sessions should occur between six to 24 hours; these authors recommend that aerobic training should be low in volume (i.e., use of HIIT with a weekly frequency between two to three days for aerobic training and two days for strength training). In this same study, there was greater muscular hypertrophy of the quadriceps following cycle ergometry when compared to the treadmill protocol. As for HIIT (7x30s intervention with 60s rest between sets, for 12 weeks), Toohey *et al*. [18] observed increases in strength and cardiorespiratory capacity in cancer survivors trained utilizing a lower volume compared to patients who completed a higher volume (30 minutes of continuous training).

The information available to date reinforces the concept that combined training (aerobic + strength) (low volume for aerobic training and frequency of three weekly workouts of strength for the whole body) can promote both strength and muscular hypertrophy.

Recent studies utilizing oncologic patients with HNC [19,20] have reported that the main barriers to participation in training programs are lack of interest, exercise as a non-priority, fatigue, and muscle weakness. Toward this end, the integration of assorted training routines that are short and enjoyable may increase the likelihood that cancer patients will engage in a physical fitness program. In addition, it is important for patients to understand that training has the ability to increase life expectancy and reduce the negative consequences associated with low aerobic capacity and cachexia.

CONCLUSIONS

Adopting a physically active lifestyle is a sine qua non condition when an individual wants to live a quality and prolonged life. In situations such as cancer, a disease that rapidly debilitates patients through the loss of muscle mass, the incorporation of physical exercises, particularly strength training, seems to play a key role in maintaining muscle mass and improving the autonomy of cancer patients. Strength training promotes increased physical fitness in cancer survivors

in general, including those with HNC. More studies are needed to verify the effects of physical training, pre, during and post cancer treatment, as well as establishing a consensus on training protocols for this population.

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