CANCER: BENEFITS OF RESISTANCE AND AEROBIC TRAINING

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ABSTRACT
The purpose of the present study was to analyze the benefits of strength and aerobic training during and after treatment with patients with cancer. This review used journals of the PubMed, MEDLINE, SciELO and LILACS databases. From the scientific evidences presented by the studies, something to highlight is that physical exercise improves functional capacity, body composition, the activity of natural killer cells (NK), the mood state and quality of life of patients with cancer. It is possible to conclude that the combination of strength and aerobic treatment may bring benefits to patients during and after cancer treatment, being well tolerated.
Key-words: Strength training. Aerobic exercise. Cancer treatment.

INTRODUCTION

Cancer is defined as an uncontrolled and abnormal growth of cells in the body (AMERICAN CANCER SOCIETY, 2005). The treatment of this disease involves the application of chemotherapy, isolated or combined with radiotherapy and/or surgery. Due to treatment, most patients present a series of secondary symptoms and side effects, such as nausea, vomit, pain, insomnia, loss of appetite, and fatigue (ADAMSEM et al., 2009).

This disease is considered multifactorial, since it has a single causative factor. Besides, physical inactivity is regarded as a risk factor for the development of cancer (FRIEDENREICH; ORENSTEIN, 2002; HAYES et al., 2009). For this reason, the scientific community has been discussing the application of physical exercise as a non-pharmacological strategy toward the prevention of the disease and the rehabilitation of individuals during and after treatment.

Such interest derives from the fact that physical exercise minimizes the degenerative processes associated with cancer, promotes behavioral changes linked to lifestyle, reduces the risks for recurrence of the disease and improves psychosocial factors (VALENTI et al., 2008). In addition, improvement of the functional capacity, mid and long term, – including increase in strength, resistance to fatigue, flexibility and aerobic capacity – and improvement of the immune system are some other benefits promoted by a physical exercise program (KISNER; COLBY, 1992).

Fairey et al. (2005), in their randomized and controlled study, demonstrated increase in the activity of natural killer cells (NK), which have antiviral and antineoplastic function, after training performed three times a week on ergometer. Additionally, studies have been demonstrating a reduction between 24% and 67% in the risk for mortality from breast cancer in physically active women, after cancer diagnosis (IRWIN et al., 2009). A recent systematic review conducted by Cheema et al. (2007) demonstrated that the performance of physical exercise combined with aerobic training two or three times a week is safe and beneficial to women with breast cancer, resulting in functional, psychological and clinical improvements. Recently, the American College of Sports Medicine (ACSM), during a special

communication about the guidelines for the prescription of exercises for cancer survivors, highlighted that physical exercise is safe during and after the various types of cancer treatment, including intensive treatments, like the hematopoietic stem cell transplantation (SCHMITZ et al., 2010).

From the exposed above, the benefits of physical exercise in cancer prevention and treatment are clear, although this subject is strongly debated and still need to be better clarified, especially when it comes to the modalities of exercises and the variables of the training. Thereby, this review aims to demonstrate and discuss possible benefits of strength and aerobic exercise programs, as well as the intensity, frequency and volume of training for patients with cancer, during and after treatment.

METHODOLOGY

This literature review has a descriptive and exploratory character and was carried out from works related to strength training and aerobic training during and after cancer treatment. Initially, the studies of interest were identified through a research on scientific databases on the worldwide web, by using a combined search of key words related to cancer (oncology and tumor), cancer treatment (chemotherapy, radiotherapy and surgery) and exercise (rehabilitation, strength training, aerobic training and quality of life). Articles on the theme, published in the last seven years, in Portuguese and English, were analyzed.

In this search, the PubMed, MEDLINE, SciELO and LILACS databases were consulted. Controlled and randomized articles were included in this article, but, due to the scarcity of these studies, non-randomized and controlled clinical studies published in magazines and newspapers were also included. Abstracts and case reports were excluded from this investigation. Studies of prescription of strength and aerobic training isolated or combined with other types of physical activities, during and after cancer treatment, were included.

CANCER AND EXERCISE

A total of 17 studies were found, published between 2003 and 2009. The results of the works were analyzed taking into consideration the effects of physical exercise on the following aspects: cardiorespiratory function, muscle strength, lymphedema, immune system, fatigue, quality of life and body composition. Six studies involved patients with breast cancer, two studies included patients with prostate cancer, three studies were about patients with leukemia and six studies were conducted with patients with several other types of cancer. Six studies showed an intervention time ranging from four months to five years after the cancer treatment, and in ten studies physical exercise was applied during cancer treatment. In all of the studies, the patients received some type of therapy, such as surgery, chemotherapy and radiotherapy.

The duration found in the studies with strength training was six to twenty-four weeks. The number of series prescribed varied from one to three, and the number of repetitions, between five and fifteen. The frequency of training was one to three weekly sessions. The intensity of the strength exercises ranged from 40% to 100% of one maximum repetition (1MR), and the most frequent stood between 40% and 70% of 1MR. It is important to stress that fifteen of the seventeen studies found carried out the combination of aerobic exercise and strength training. The aerobic exercise programs, in general, used as ergometer a bicycle ergometer. The duration of the training session was six to forty-five minutes. The intensity used in the studies was 30% to 100% of the maximum heart rate (HRmax) or of the maximum oxygen

consumption (VO2max), and the most frequent ones were those between 40% and 75% of the HRmax or VO2max.

Effect of exercise on the cardiorespiratory function

Fours studies analyzed the cardiorespiratory function; three studies presented significantly positive results. Adamsen et al. (2003) demonstrated increase in the aerobic capacity after six weeks of strength training combined with aerobic exercise, at intensities of 60% to 100% of the HRmax on bicycle ergometer, during the treatment of patients with various types of cancer. San Juan et al. (2008) showed significant increase in the consumption of peak oxygen (VO2peak) in children with leukemia in only eight weeks of intra-hospital intervention. The exercise program consisted of strength training associated with aerobic exercise, with duration of ten to thirty minutes, at 50% to 70% of the HRmax. De Backer et al. (2007) evidenced that a period of 18 weeks induced an increase of the VO2max, with training sessions lasting 16 minutes, on bicycle ergometer, at intensities from 30% to 65% of the VO2max. Corroborating the aforementioned studies, Battaglini et al. (2009) evidenced improvement in the cardiorespiratory capacity of ten patients with leukemia. In light of these results above presented, the potential effect of physical exercise to improve the aerobic capacity of patients with several types of cancer, during and after treatment, becomes evident.

Effect of exercise on muscle strength

Most of the studies reported increase in muscle strength assessed through the one maximum repetition test (1MR). Five studies evidenced significant increase in muscle strength after the training period. Adamsen et al. (2003) and Battaglini et al. (2006) demonstrated increase in muscle strength in patients with several types of cancer and breast cancer, respectively.

In other study, conducted by San Juan et al (2007), the muscle strength of the upper and lower limbs increased after a period of sixteen weeks, with three weekly sessions. After this period, the individuals underwent a detraining of 20 weeks, and decrease in strength was not observed. Similarly, Schneider et al. (2007) conducted a study with 270 patients with breast or prostate cancer, who survived the disease, during and after treatment, having observed significant improvement in muscle strength.

San Juan et al. (2008) also found significant improvements in muscle functional capacity and muscle strength after eight weeks of strength and aerobic training. This training program was applied inside a hospital to children with leukemia, after one year of hematopoietic stem cell transplantation.

De Backer et al. (2007) carried out a high-intensity training program for patients with many types of cancer, during 18 weeks, and found significant improvement in muscle strength; the patients tolerated the program well, six weeks after treatment. In this sense, it is possible that the inclusion of strength training in the intervention with exercise results in an increase in the strength of patients with cancer.

Effect of exercise on the lymphedema

Lymphedema is the accumulation of proteins in body fluids, characterized by hands, arms and chest swelling. It is common in patients with breast cancer (SCHMITZ, 2010). Mackenzie

and Kaldar (2003) showed that strength training did not change the circumference and volume of the upper limbs of women with lymphedema, after cancer treatment. In this way, Courneya et al., (2007) also verified that exercise did not cause lymphedema. In said study, the training program consisted of a combination of strength and aerobic trainings, and no type of alteration related to the development of lymphedema was observed in women with breast cancer.

Ahmed et al. (2008) conducted a clinical and controlled study during six months, aiming to analyze the relationship between exercise and lymphedema in breast cancer survivors. This study demonstrated that strength training did not promote the development of lymphedema, and no alteration in the perimeter of the arm was observed. Finally, contrarily to what could be imagined, exercises with the upper limbs do not cause or worsen the lymphedema in patients with breast cancer (SCHMITZ et al., 2010). It is worth highlighting that, in cases of acute lymphedema, with pain symptomatology, the exercise will be able to be interrupted according to medical prescriptions.

Effect of exercise on the immune system

Fairey et al. (2005) observed significant increase in the activity of NK cells (cells that have antitumor action) after a period of aerobic training of 15 weeks, with 70% to 75% of the VO2max.

Kelm et al. (2000) investigated the effect of a thirteen weeks strength and aerobic training program, performed twice a week, on patients with cancer and subjected to chemotherapy, and observed increase in the number of NK cells. This immunological activation was followed by the increase in physical performance and strength, and improvement in quality of life.

A study conducted by Peters et al. (1994) also demonstrated increase in the activity of NK cells after seven months of strength training in postmenopausal patients with breast cancer. In spite of the reduced number of studies, physical exercise may induce the increase in the activity of NK cells, thus improving the immune response to cancer; however, other studies still need to elucidate the effects of exercise on the immune system of patients with cancer. Thereby, these results should be interpreted with caution and other immune variables need to be investigated, such as the production of immunoglobulin, presentation of antigen, microbicide activity, the cytotoxicity of lymphocytes, apoptosis, phagocytosis and others.

Effect of exercise on fatigue

Fatigue is one of the side effects most commonly reported by patients with cancer (DIMEO et al., 1997). Battaglini et al. (2006) found significant decrease in fatigue levels after twenty-one weeks of moderate exercise, performed twice a week, in patients with breast cancer, after surgery. The result of this study suggest that strength training should be included in exercise programs for the combat to fatigue and for the improvement in muscle strength of women with breast cancer. Segal et al., (2009) demonstrated reduction in fatigue in patients with prostate cancer who underwent radiotherapy, after twenty-four weeks of training.

Adamsen et al. (2009) showed that high-intensity exercise reduced fatigue in patients subjected to chemotherapy. Similarly, Battaglini et al. (2009) found significant reduction in fatigue scores in patients with leukemia who trained three times a week, twice a day. Therefore, the intervention with strength and aerobic exercise may reduce the fatigue levels of people with cancer.

Effect of exercise on quality of life

The vast majority of the studies included in this review found improvement in quality of life with the practice of physical exercise. De Backer et al. (2007) evidenced that all EORTC QLQ-30 functional scales, except for the cognitive, improved after high-intensity training of eighteen weeks. San Juan et al. (2008) also found improvement in quality of life in a study with children with leukemia who underwent hematopoietic stem cell transplantation. The authors commented that children with leukemia can be safely subjected to an intra-hospital supervised conditioning program and that this program will have to include strength and aerobic exercises, because children who perform physical exercise after the transplantation obtain benefits to their global health, after a short period of eight weeks. Adamsen et al. (2009) showed that six weeks of exercise resulted in a significant improvement in seven of the ten items in the scale of overall well-being.

On the other hand, in the study by Courneya et al. (2007) with strength and aerobic exercises there was no significant improvement in the quality of life of patients with breast cancer subjected to chemotherapy. In spite of that, there was improvement in self-esteem, physical conditioning, body composition and conclusion rate of the chemotherapy without causing lymphedema. Adamsen et al. (2009) analyzed quality of life through the SF-36 questionnaire and found significant improvement in the physical aspect, with a trend to improvement of the scores of pain, overall health status, vitality, social aspect, mental health and emotional health. Considering the aforementioned studies, it is possible to conclude that exercise programs that include strength and aerobic training improve the quality of life of patients with several types of cancer.

Effect of exercise on body composition

A few studies show the positive effects on the body composition of patients with cancer. In a study conducted by Battaglini et al. (2007), there was increase in lean mass and reduction in fat mass in patients with breast cancer subjected to twenty-one weeks of aerobic and strength training during treatment. According to the authors, evidences provide support to exercise as a method to reduce negative variations in the body composition and strength of most patients under treatment. Segal et al. (2009), in their randomized and controlled study, assessed the effects of twenty-four weeks of strength and aerobic training and observed improvements in the concentration of triglycerides and body fat in patients with prostate cancer subjected to radiotherapy. In agreement with these findings, Courneya et al. (2007) also verified positive effects on body composition.

Contrarily, Segal et al. (2003) did not observe any changes in the body composition of men with prostate cancer subjected to androgen deprivation therapy. Thereby, the effects of physical training on body composition still needs to be better clarified in relation to the various types of cancer, since the forms of treatment may limit the gain of lean mass and/or the reduction in fat mass. For instance, the androgen deprivation therapy used in the prostate cancer treatment may impair the gain of muscle mass.

Recommendation for the prescription of exercises to patients with câncer

The present review summarizes the research of studies that used strength and aerobic trainings during the period of treatment and post-treatment of patients with several types of cancer. In most of the studies, the individuals underwent chemotherapy, radiotherapy and/or surgery. The results should be interpreted with caution, because studies are still scarce and need more epidemiological data. Battaglini et al. (2004) suggest that physical exercise of moderate intensity may promote a physiological stimulus sufficient to

improve the muscle development of cancer survivors, even during or after treatment. To De Backer et al. (2007), the practice of physical exercise at high intensity brings better benefits to patients with cancer. Said study makes a criticism to the ACSM regarding the exercise protocol for this population, which proposes an intensity of 50% of 1MR with two or three series of ten to twelve repetitions. From a physiological perspective, these orientations seem to be suboptimal for training. The reasons appear logic, because in 2003, when the proposals were formulated, the research on strength training was very limited.

In spite of the different methodologies used in the studies, it is being already demonstrated that strength training is more efficient at moderate to vigorous intensities, that is, six to twelve maximum repetitions (MR). Moreover, according to Ott et al. (2004), other tissues, like the osseous, also responded positively to heavier intensities. This question is clinically important, because during menopause, breast cancer survivors have a mineral density below normal average and strength training decreases the osseous loss. It is worth stressing that, as shown in Table 1, the intensities and volumes must be reduced in the treatment phase in relation to the post-treatment phase.

Additionally, it has been demonstrated that weight training do not onset or worsen the symptoms of lymphedema (AHMED et al., 2008), which agrees with data by Courneya et al. (2007), Mckenxie and Kaldar (2003).

Finally, taking as a basis all studies analyzed in this review, Table 1 presents some suggestions for the prescription of physical exercises for patients with cancer during and after treatment. It is important to highlight that the intensities and durations are different between the treatment and post-treatment periods, and that these suggestions are not fixed, being subject to changes depending on the clinical state of the patient. In case the strength and aerobic trainings are combined, the durations suggested must consider the division of time between both modalities. For instance, after treatment, the recommended duration is sixty minutes, distributed into thirty minutes for each modality.

CONCLUSION

It is possible to conclude that the combination of strength and aerobic trainings may bring benefits to patients during and after cancer treatment, being well tolerated by patients. Evidently, the positive effects of exercise may vary significantly due to the type of cancer, the intensity, the frequency and duration of the exercise program and the patient's lifestyle.

Based on these findings, it is suggested that strength and aerobic trainings should be included in the rehabilitation of patients with cancer, but the cautious selection of the patients and especially the supervision during the training are essential, as well as medical monitoring. In spite of the body of scientific evidences presented in the present review, it is still necessary to establish the best type of exercise for patients with cancer during and after treatment. A larger number of researches are needed to specify the best modality and response-dose of exercise for each form of cancer.

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