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Full Length Research Paper

The role of exercise in the breast cancer related lymphedema

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The upper extremity breast cancer related lymphedema is a result of the surgery and /or radiation in the axillary lymph node due to interference of the lymphatic drainage of the affected area. Lymphedema is presented as a chronic swelling of the limb followed by pain, changes in the appearance of the skin, difficulty in moving of the joints and infections. These symptoms significantly affect the quality of life of the patient. The main risk factors for developing lymphedema include stage of cancer, the type of surgery, the surgical removal or/and radiation of axillary lymph nodes, the number of retrieved lymph nodes, the exposure to high temperatures and obesity. Lymphedema is irreversible so it is imperative to inform patients about risk factors and how to prevent and control it when is installed. In this point exercise can have significant benefits for breast cancer survivors during and after treatment. Furthermore participation in an upper body exercise program caused no changes in arm circumference or arm volume in women with lymphedema after breast cancer and exercise generally encourages skeletal muscle contractions to provide the primary pumping mechanism for lymphatic and venous drainage and therefore stimulates the contraction of lymph vessels.

Key words: Lymphedema, exercise, breast cancer, aerobic exercise.

INTRODUCTION

Lymphedema is a type of edema that occurs due to an abnormal accumulation of lymphatic liquid in the space between the cells and tissues of the body (Foeldi et al., 2003). It is a clinical condition that appears when the lymphatic transport system fall below the capacity needed to handle the fluids that normally goes from blood vessels into the lymph system. Lymphedema of upper limb is related to the breast cancer as a result of an operation and/or of radiation in the underarm lymph nodes. Lymphedema is among the serious concerns of breast cancer survivors as it is not reversible and may cause number of problems such as pain, changes in the skin, difficulty in movement of articulations and other infections. Breast cancer survivors may find lymphedema more distressing than mastectomy as it is less possible to hide the physical manifestation and loss of arm function that negatively affect many aspects of daily life. Lymphedema is a chronic disease that may be managed but without a cure (Petrek et al., 2000).

The treatment recommended for lymphedema is a combination of therapies including lymph drainage (Brautigam et al., 1998; Godoy et al., 2004), exercising (Johanson et al., 2005; Godoy et al., 2008a; Picket et al., 2002), hygienic care (Godoy et al., 2008a) and more recently the association of occupational activities with comparison mechanisms and cervical stimuli (Godoy et al., 2008b). The exercises used to treat lymphedema should be programmed controlled muscle activities to improve the physical condition without competitive objectives (Godoy et al., 2009). Even so, it is very important to consider the principles of biomechanics, velocity, duration and positioning with this approach to therapy (Mc Neely et al., 2010).

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Table 1. The impact of secondary upper limb lymphedema after treatment of breast cancer in relation of the therapeutic method.

Number of patients	Lymphedema
(n=5898)	(n=1405)
Radical mastectomy without radiotherapy.	22.3%
Radical mastectomy and radiotherapy included axillary area.	44.4%
Amended radical mastectomy without radiotherapy.	19.1%
Amended radical mastectomy and radiotherapy.	28.9%
Partial mastectomy without radiotherapy.	6.7%
Partial mastectomy and radiotherapyincluded axillary area.	10.1%

Table 2. The impact of chronic upper limb lymphedema after treatment of breast cancer in ralation of the number of the removed lymph nodes.

Number of lymph node	Impact of edema (%)
0	21
1-10	38
11-15	27
>15	44

PATHOGENESIS

The cause of breast cancer related lymphedema remains partially without refinement. It seems to be associated with a variety of factors, mostly with those that cause trauma to region. Thus, catalytic role in the pathogenesis is generally considered to play the initial treatment (surgery and / or radiation) in auxiliary lymph node area. The failure of lymphatic system of the limb then contributes to chronic accumulation of lymph and a number of vascular and tissue changes that have as a result the accumulation of protein in tissues (Kosmidis et al., 2009). Furthermore, the metabolism processes in the interstitial tissue are disrupted by swelling and the procedure of inflammation is facilitated with all its negative consequences for the circulation of lymph (Sakorafas et al., 2006).

Variety of lymphoid characteristics of the individual in conjunction with compensatory responses of the body may be responsible for the selective development of lymphedema in some patient groups (Rock et al., 2002). It is estimated that 17% of women undergoing axillary intersection will develop at some time in their life lymphedema. When the treatment is a combination of surgery and radiation then the rate can be increased up to 44% (Kim et al., 2003).

The main risk factors for developing lymphedema include stage of the cancer and the type of surgery as it shows the study of Schuenemann and Williich (Table 1). Late stage during the phase of diagnosis is linked with increased incidence of lymphedema development, mainly due to more aggressive surgical treatment of these patients in combination with radiation of axillary lymph (Ozaslan et al., 2004).

Surgical removal of axillary lymph nodes and/or radiation is related to almost every case with the risk of developing lymphedema (Kosmidis et al., 2009). This risk, which occur much greater in patients with positive nodes who underwent resection or radiation, is proportional of their number as described by Kiel and Rademacher (Table 2) (Stanton et al., 2006).

The growing trend of non-consecutive radical surgery appears to reduce but not eliminate the risk for lymphedema. It is observed that surgical approach to axillary region via sentinel lymph node biopsy, improves the morbidity of the upper edge, directly reducing the development of lymphedema. Long-term results related to the contribution of the biopsy of the sentinel lymph nodes have not published yet (Mansel at al., 2006).

The age in which the lymphedema appears usually, studies record a greater subjective report of symptoms in young ages (Armer et al., 2005a). This comes in contrast with significantly greater recording findings in older women (> 55 years) through objective measurement of the circumference of the arm (Heidrich et al., 2006). This difference is obviously not measurable and probably due to the tendency of older women to perform the symptoms lymphedema in the aging process, as opposed to

immediate and intense labeling of each operating limitation caused by the lymphedema in young and more active women (Armer et al., 2005a; Heidrich et al., 2006).

Many studies in the past have tried to connect lymphedema with the main extremity (left or right) that the patient uses (Voogd et al., 2003). A more recent big research does not seem to support this correlation.

There is almost always a higher incidence of lymphedema development in patients in dynamic workplace. Infected edge appears with reduced functionality which limits the performance of the patient in the workplace. A small percentage of patients with lymphedema have noticed deterioration during air flights but the findings are likely to be random and therefore the recommendation to avoid air travel would be excessive (Graham, 2002).

An important factor in worsening lymphedema is the high temperature. For this reason is advised to avoid exposure of the affected limb in warm baths (i> 38°C) or sauna more than 15 min. Similarly the tropical climate could also be considered an aggravating factor, but yet have not been elucidated a possible association (National lympedema Network, 2005).

Regarding the execution of exercises that could prevent or reduce lymphedema some studies indicate that the application of appropriate exercise is recommended for at least a year after surgery as it helps to develop collateral circulation to the shoulder and the scapula. These exercises are balancing the operation of vessels destroyed during treatment (Cheema et al., 2006). Also it encourages skeletal muscle contractions to provide the primary pumping mechanism for lymphatic nod venous drainage and therefore should stimulate the contraction of lymph vessels because these vessels are innervated by the sympathetic nervous system (McKenzie et al., 2003). Thus the patients recover some of the lost muscle strength, mobility and functionality of the limbs returning earlier in their activities that have had before the operation.

The progressive, controlled upper-body exercise program does not significantly affect the volume of the upper extremities in women with lymphedema after breast cancer treatment. This finding is valid independent of the method used to quantify limb volume (McKenzie et al., 2003). There are several reasons to suggest the use of a gradual, progressive upper-body exercise program in the rehabilitation of lymphedema (McKenzie, 1998). Lymph is propelled by both passive and active forces. Passive forces are already promoted as treatment for lymphedema: manual lymphatic drainage, massage therapy, sequential pneumatic compression pumping, elastic compression sleeves, and limb elevation. These treatments mimic the passive forces of the body, such as skeletal muscle pumping, respiratory movement and arterial pulsation. Exercise also stimulates the skeletal muscle to pump venous and lymphatic fluid (White, 1987). This type of exercise should also stimulate the contraction of the lymph vessels themselves because these vessels are innervated by the sympathetic nervous system. Regaining control over these internal contractions by resetting the sympathetic drive to these vessels through upper-body exercise may assist in the long-term treatment for lymphedema (McKenzie et al., 2003).

Numerous studies also indicate a statistically significant correlation between obesity and the development of lymphedema.

The results are based on measuring the Body Mass Index (BMI) increases the chances of lymphedema in patients with BMI > 25 kg/m^2. The higher body weight increases the required radiation dose and the possibility of infection, while reducing healing capacity, factors that reinforce the future appearance of lemphedema (Geller et al., 2003). Additional and under 20 year retrospective study, the increased weight during cancer treatment breast proved more important factor causing lymphedema than pre-existing obesity in the initial phase of diagnosis. Also, most patients developed lymphedema are characterized by reduced mobility which promotes and enhances weight gain this vicious circle (Vigres et al., 2006).

CLINICAL PICTURE

The stages of lymphedema are:

Stage 1 or reversible stage: The pressure causes imprinting in the region, while the swelling subsides temporarily if the limb is placed at the elevated position.

Stage 2 or non-independent reversible stage: If the lymphedema is not treated promptly and continue to occur, will lead sooner or later in a progressive hardening of the area. The possibility of creating imprinting decreases constantly while at the end is no longer feasible. The elevated position does not lead to reduce swelling.

Stage 3 or elephantiasis: In this stage there is large increase of swelling, hardening of the skin (pachyderm) and development of sarcomas (Stanton et al., 2006).

These physiologic changes may result in decreased range of motion and function decreased muscle strength, and the need to alter choice of clothing and several activities of daily living including household duties, sleep, employment and leisure time physical activity (Haid et al., 2002).

Also significant psychosocial morbidity, depression and social inhibition have all been described in association with lymphedema (Schmitz, 2009a).

Effect – diagnosis

Estimates of the incidence of lymphedema and the prevalence in the population of female patients vary widely in the literature. This is because of short-term follow-up and lack of specific diagnostic criteria, leading to inaccurate recording of the population survey and symptoms (Armer et al., 2005b). Specifically according to Clark et al. (2005) patients that were treated with biopsy or auxiliary lymph node resection developed lymphedema at a rate of 20.7% over the next 3 years after surgery. This is important because it has been observed that the greater effect of lymphedema occurs within 2 to 3 years after surgery, although the timeframe that is given from the majority of studies include the immediate postoperative time until 30 years after surgery (Geller et al., 2003).

The collection of information is mainly based on two methods: the report of symptoms by patients themselves and in the measurement of size of edema, or by measuring the region of the limb, either through the volumetric displacement of water. These methods can affect the objectivity of the results, as in most cases it is observed asymmetry of limbs, while rarely the physician make a preoperative measurement of limbs so they can compare the postoperative results. Therefore by the patients which through study and research are recorded display lymphedema, only half of the diagnosis is eventually correct (Tewari et al., 2008). Of course sometimes the start of symptoms preceded the change in size of the limb and therefore the reference to any symptoms from the patients themselves should be taken always seriously (Pain et al., 2008).

The lemfos single photon emission computed tomography (SPECT), an imaging technique of nuclear medicine, helps to explore the preoperative and postoperative risk in patients with breast cancer to develop lymphedema (Gebousky et al., 2008). Modern methods such as bioelectrical impedance analysis (BIA) and that of low frequency oscillations (deep oscillation) help also the diagnosis, providing more reliable information that was not possible with most traditional methods of the past, such as measuring the circumference of the arm (Francis et al., 2006).

RELATION BETWEEN BREAST CANCER LYMPHEDEMA AND EXERCISE

Many studies on post cancer exercise tested an aerobic exercise prescription that mirrors the guidelines recommended by the American College of Sports Medicine (American College of Sport Medicine, 1998). In brief, each study prescribed 3 to 5 days per week of an aerobic activity that can be maintained continuously for 20 to 60 min at a moderate intensity. These studies have clearly shown that many breast cancer survivors, even during adjuvant therapy, can adhere to a conventional exercise prescription. As far as concerns exercise type, walking is the natural choice of most survivors and has direct implications for activities of daily living. Cycle ergometry offers advantages that include a sitting position and leg exercise that minimize the effects of ataxia, cognitive impairment, limitations in upper – extremity movement, and arm lymphedema (Courneya et al., 2002).

It should be noted that upper-body exercises such as swimming and rowing, are not necessarily contraindicated. Research has shown that earlier concerns about vigorous upper-body exercise inducing lymphedema have been unfounded (Hock, 1998). Consequently, breast cancer survivors should be encouraged to follow both an aerobic and strength training program. Although high intensity exercise should probably be avoided during treatments because of the potential immunosuppressive effects (Shephard et al., 1999) it is not contraindicated after treatment. As a precaution, however, it is recommended that breast cancer survivors wear compression sleeve on the arm of the affected side during upper-body exercises.

DISCUSSION

Strategies which seems to play a major role in conservative treatment is the manual lymphatic drainage, the multilayer compression, bandaging, the antibiotics (in case of infections), the corticosteroids and of course the exercise (Brunet et al., 2012). According to American Cancer Society the breast cancer lymphedema must be undertaken by the appropriate therapist and the good cooperation between patient and therapist is desirable.

Several studies so far have been made about the need for exercise in patients with lymphedema. McKenzie and Kalda (2003) examined the effect of a progressive upper body exercise program on lymphedema secondary to breast cancer treatment and concluded that upper – body aerobic exercise is beneficial for women with secondary lymphedema after breast cancer treatment. Exercise helps to express and to feel more confident using these women the affected arm for activities of daily living, and some of them have mentioned that they have returned to lifting objects or carrying groceries with the arm. This may explain the trend toward increased general health and vitality scores, in as much as the exercise subjects were reminded less often of their disease and therefore felt healthier overall. The decrease in physical functioning scores in the control group perhaps represents the normal progress of the disease, with the arm gradually becoming more congested over time. It appears that upper-body aerobic exercise may result in an improvement in physical functioning (McKenzie et al.,

2003).

Also according to Schmitz (2009) in an article published in New England Journal of Medicine contrary to common guidelines to avoid lifting with the affected limb, weight lifting did not significantly affect the severity of breast cancer lymphedema. In addition, weight lifting reduced the number and severity of arm and hand symptoms, increased muscular strength, and reduced the incidence of lymphedema exacerbations. There is evidence that exercise enhances the flow of lymph and improves protein desorption and that the increased pulmonary work associated with exercise assists with lymph flow. It is also possible that increased muscle strength reduces the relative effect of common daily stresses to the limb (Smhmitz et al., 2009b).

In the case of women at risk for breast cancer related lymphedema a research on exercise by Harris and Niesen-Vertommen (2000) suggested that these women who had undergone treatment for breast cancer could engage in upper extremity exercise without developing lymphedema (Harris et al., 2000). All women in the research had undergone level I or II axillary node dissection and 13 from 20 also had undergone radiation treatment. The training program consisted of 20 to 30 min of aerobic exercise plus stretching and resistance training for the upper extremity and back muscles. The women were advice to wear compression sleeves, although adherence to this advice was not reported. Upper extremity circumference measurements were taken at the beginning of training. At the end there were no clinically important differences in circumference between the ipsilateral and contra lateral upper limbs for any of the women (Bicego et al., 2006).

In another pilot study published by Kolden et al. (2002), examined the feasibility, safety and benefits of a structured group exercise program. He studied 40 women who had been surgically treated for breast cancer. These women had been diagnosed with stage I to III breast cancer with no reported lymphedema. 83% of the women were within 12 months of diagnosis, most were currently undergoing adjuvant therapies. Participants completed a 16 week intervention consisting of a 10 to 15 minute warm up of slow, 20 min of aerobic exercise, and 20 min of resistance training and cool down combined. Outcome measures included blood pressure, heart rate, weight, body fat, aerobic capacity, flexibility, strength and also quality of life. The fact that participants completed an average of 88% of the sessions showed the safety and tolerability of the study. Significant improvements were noted in resting systolic blood pressure, flexibility, aerobic capacity and strength on the bench press and leg press, as well as in 4 of 5 mood/distress measures, the global measure of well-being, and scores of global functioning. None of the participants reported any adverse events, including lymphedema (Kolden et al., 2002).

Previously, the idea that aerobic exercise and upper extremity resistance training should be contraindicated for women with breast cancer was widely accepted. Recent studies have provided preliminary evidence to suggest that exercise may be safe. The studies examined the effects of various exercise programs and concluded that exercise neither initiated nor exacerbated lymphedema (Courneya et al., 2003).

The results of Schmitz 's studies also reduces concern that weight lifting will worsen arm and hand swelling associated with lymphedema in breast cancers survivors (Smhmitz et al., 2009b). These findings support the potential benefits of a slowly progressive weight- lifting program in women with breast cancer- related lymphedema.

A lot of studies have indicated the negative relation between patient's lymphedema and distress. The most of studies focus on this problem in the exact relation between cancer and distress. The problem seems to be intensified when a patient with a breast cancer suffers from lymphedema . Newman et al correlate the breast cancer lymphedema with distress. One third of the lymphedema patiens seem to appear distress (Newman et al., 1996). Another study with two hundred two patients in China show that the women with Ca breast lymphedema had inferior quality of life compare with those who did not suffer from Ca breast lymphedema (Mak et al., 2009).

Concluding, the benefits of exercise seem to be important to a patient suffering from breast cancer related lymphedema. Aerobic type of exercise seems to t be more beneficial than others and 3 to 5 times per week the ideal frequency for this type of patients.

Key messages

1. The type of surgery with the largest percentage of developing lymphedema is radical mastectomy in combination with radiotherapy in axillary area.
2. Lymphedema of upper – extremity may be accompanied by pain, changes in the skin, infections and difficulty in movement of the joint.
3. Upper-body aerobic exercise act beneficial in many ways for women with secondary lymphedema after breast cancer treatment.
4. More randomised studies will help to understand the relationship between Ca breast lymphedema and aerobic exercise.

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