

Post-mastectomy lymphedema: a treatment protocol

Linfedema pós-mastectomia: um protocolo de tratamento

Linfedema post-mastectomía: un protocolo de tratamiento

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ABSTRACT | Lymphedema is still considered as one of the main sequela resulting from surgical treatment of breast cancer. The aim of this study was to evaluate the efficacy of a protocol that included use of a high-voltage electrical stimulation (HVES) associated with therapeutic exercises, self-massage, and self-care for the treatment of lymphedema of the upper limbs in women who underwent surgery for breast cancer treatment. This study included 17 volunteers (60.9±11.72 years of age) submitted to unilateral mastectomy, with lymphedema of the upper limb, ipsilateral to surgery. The treatment consisted of application of 14 HVES, to the patients, twice a week, supplemented by guidance on self-care, self-massage, and physical exercises. The evolution of this treatment was assessed by perimetry, calculation of the volume difference (VD) between the limbs, and calculation of the volume increase percentage (VIP) of the affected limb compared to the contralateral limb. Data were analyzed using the statistical method for paired T and dependent variables, which showed a significant reduction of 14.13% (p=0.0067) in VIP and 13.8% (p=0.0089) in VD, as well as perimetry at the following three points: 7 cm above the elbow (p=0.0138), 7 cm below the elbow (p=0.0282), and at the wrist (p=0.0476). It was concluded that the use of HVES associated with the exercises and guidance on self-care and self-massage was effective to reduce the lymphedema in the evaluated group.

Keywords | breast neoplasms; lymphedema; rehabilitation

RESUMO | O linfedema ainda é uma das principais sequelas decorrentes do tratamento cirúrgico do câncer de mama. O objetivo do estudo foi avaliar a eficácia de um protocolo que inclui a utilização da estimulação elétrica de alta voltagem (EEAV) associada a exercícios terapêuticos, automassagem e autocuidados no tratamento do linfedema de membros superiores em mulheres submetidas a cirurgia para tratamento do câncer de mama. Participaram do estudo 17 voluntárias (60,9±11,72 anos) submetidas à mastectomia unilateral, portadoras de linfedema de membro superior, homolateral à cirurgia. O tratamento constituiu-se de 14 aplicações da EEAV, duas vezes por semana, complementadas por orientações quanto ao autocuidado, automassagem e exercícios físicos. A evolução do tratamento foi avaliada por perimetria, cálculo da diferença de volume (DV) entre os membros, e percentual de aumento do volume (PAV) do membro afetado em relação ao contralateral. Os dados foram analisados por meio do método estatístico T pareado para variáveis dependentes e revelaram redução significativa de 14,13% (p=0,0067) do PAV e de 13,8% (p=0,0089) da DV, bem como da perimetria em três pontos: sete centímetros acima do cotovelo (p=0,0138), sete centímetros abaixo do cotovelo (p=0,0282) e no punho (p=0,0476). Pôde-se concluir que a utilização da estimulação elétrica de alta voltagem associada a exercícios e orientações foi eficaz na redução do linfedema do grupo avaliado.

Descritores | neoplasias da mama; linfedema; reabilitação.

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RESUMEN | El linfedema todavía es una de las principales secuelas derivadas del tratamiento quirúrgico del cáncer de mama. El objetivo del estudio fue evaluar la eficacia de un protocolo que incluye la utilización de estimulación eléctrica de alto voltaje (EEAV) asociada a ejercicios terapéuticos, automasajes y autocuidados en el tratamiento del linfedema de miembros superiores en mujeres sometidas a cirugía para el tratamiento de cáncer de mama. Participaron del estudio 17 voluntarias (60,9±11,72 años) sometidas a mastectomía unilateral, portadoras de linfedema de miembro superior, ipsilateral a la cirugía. El tratamiento consiste en 14 aplicaciones de EEAV, dos veces por semana, complementadas por orientaciones en el autocuidado, automasaje y ejercicios físicos. La evolución del tratamiento fue evaluada por perímetros, cálculo

de la diferencia de volumen (DV) entre los miembros y porcentaje de aumento del volumen (PAV) del miembro afectado en relación al contralateral. Los datos fueron analizados por medio del método estadístico T pareado para variables dependientes y revelaron reducción significativa de 14,13% ($p=0,0067$) del PAV y de 13,8% ($p=0,0089$) del DV, también en los perímetros en tres puntos: siete centímetros encima del codo ($p=0,0138$), siete centímetros abajo del codo ($p=0,0282$) y en la muñeca ($p=0,0476$). Se puede concluir que la utilización de la estimulación eléctrica de alto-voltaje asociada a ejercicios y orientaciones fue eficaz en la reducción del linfedema del grupo evaluado.

Palabras clave | neoplasias de la mama; linfedema; rehabilitación.

INTRODUCTION

It has been estimated that in Brazil during 2012, more than 50,000 new breast cancers¹, including different therapeutic conducts, were reported. However, depending on the severity of the case or on the tumor staging, surgery is still the first choice for treatment of breast cancer. In Brazil, one of the factors that raise difficulties for the treatment of breast cancer is assessing the advanced stage of the cancer during diagnosis, decreasing survival chances, and compromising the therapeutic outcomes².

The development of the sentinel lymph node biopsy technique for treating breast cancers reduced the need of axillary lymphadenectomy, which makes the surgery less aggressive³. Although the involvement of the lymphatic system in lymphedema development is established⁴, a recent study highlighted the involvement of blood circulation⁵.

Clinical factors have also been indicated as risks for lymphedema development, such as high body mass index (BMI), blood hypertension, history of infection or inflammation, excessive use of the limb, exposition to high temperatures, local traumas, seroma, appearance of early post-surgery edema, and arterial and venous blood circulatory changes⁶.

A literature review study showed prevalence of 6% (England, 2003) to 49% (USA, 2001), and incidence of 0% (USA, 2002) to 22% (USA, 2004) of post-mastectomy lymphedema, depending on the criteria adopted for measuring and defining the lymphedema, during the time from surgery to evaluation, and on the characteristics of the studied population⁷.

The lymphedema may present the following symptoms: volume increase in the limb, change of skin mechanical proprieties, sensitive changes, predisposal to systemic and local infections, development of secondary

malign diseases, stiffness and decrease in the movement amplitude (MA) and, consequently, functional decrease of the involved upper limb. Besides these physical symptoms, the patient may also present lowering of self-esteem, and problems with body image and social acceptability^{8,9}.

For the International Society of Lymphology⁴, the main physical therapeutic treatment for the lymphedema is the complex physical therapy (CPT), which is a technique that combines manual lymphatic drainage (MLD), functional compression wrapping, therapeutic exercises, skin care, lymphatic self-massage, and use of elastic wrap. However, total reduction of the lymphedema and maintenance of the result obtained from this treatment, are still a great challenge¹⁰.

The high-voltage electrical stimulation (HVES) has been investigated, and it seems to be a new alternative for the lymphedema treatment^{11,12}. Therefore, the hypothesis of this study is based on the possibility that HVES, when associated with therapeutic exercises, self-massage, and self-care, can be a supplement to treat lymphedema due to mastectomy.

The objective of this study is to assess the efficacy of a therapeutic protocol including use of HVES, associated with therapeutic exercises, self-massage, and self-care to treat lymphedema in women who underwent the unilateral surgery for breast cancer.

METHODOLOGY

Women who participated in the activities at Núcleo de Ensino, Pesquisa e Assistência na Reabilitação de Mastectomizadas (REMA) of Escola de Enfermagem de Ribeirão Preto at Universidade de São Paulo

(EERP/USP) were invited to join the study. These women had also undergone mastectomy and unilateral axillary lymphadenectomy, with mild and moderate lymphedema — mild if the difference is lower than 3 cm, moderate from 3 to 5 cm; and severe when it is higher than 5 cm¹³. Also, these women should not present skin injuries in the affected limb, should not be using an elastic wrap, and should not be carrying out radiotherapy and chemotherapy.

The study was approved by the Research Ethics Committee of EERP/USP (protocol number 0790/2007).

Amongst the 193 women, selected through the monthly control form of upper limbs measures and REMA records, 22 women met all the criteria and accepted to participate in the study. From these participants, five were excluded from the group because they gave up or were unable to come for the follow-up twice a week, per the requirement of the protocol of the study.

The sample was calculated based on the pilot study, with an 80% statistical power and level of significance was found to be as $\alpha \leq 0.05$ error. The program used was Statmate 2 (GraphPad Software, version 2.0), with a minimum number of 20 volunteers in the sample.

The protocol of this study included 14 sessions, two of them happened twice a week, with transcutaneous nervous electrical stimulation, high-voltage current, exercises, self-massage, and self-care guidance.

The equipment, Neurodyn High Volt® (IBRAMED), was used for the electrical stimulation, according to the criteria established in the study performed by Garcia and Guirro¹¹, unipolar technique (negative), 50 Hz, 3:9 s on/off, 2:1 s rise/decay, synchronically, motor threshold in the highest intensity tolerated by the volunteer for 20 minutes.

The silicone electrodes (5×3 cm) were positioned on the upper limb (anterior face of the forearm and arm) and the dispersive electrode (10×18 cm) was placed at the ipsilateral scapula level.

The physical exercises, per the protocol, were carried out twice a week in groups and were followed in the following three phases: gradual warming of the muscle chains; exercises to increase articular amplitude; and muscle stretching and relaxation¹⁴.

The volunteers were oriented to perform self-massage once a day, which consisted of making 20 slowly and smooth circular moves in the contralateral axillary region and in the ipsilateral inguinal region, both at surgery. Sequentially, semi-circled moves were performed, starting in the massaged areas up to the ipsilateral axillary region at surgery, repeating them three times¹⁴. The volunteers were also guided about care concerning the ipsilateral limb at surgery, such as avoiding traumas, injuries, and excessive exposure to sun or heat, skin hydration, etc².

Sociodemographic and personal data about breast cancer treatment and the weekly frequency of self-massage and home exercises were collected from and registered by the patient in a table with daily notes, which were checked by the evaluator on a weekly basis.

Limb perimetry, was always performed by the same technical expert evaluator, in seven points from the elbow line, in every 7 cm, to obtain three points in the arm; the third one was marked from the second point, with the necessary distance to reach the armpit line. Likewise, in the forearm, measures were taken every 7 cm from the elbow line; the third one at a distance, required to reach the wrist line. These values defined cut-off cones formed in the points of circumferences measure from the seven points included in the arm and forearm. The volume (V) measure of the upper limb was performed indirectly by summing up the approximate volume of the six cut-off cones, which were formed in the points of circumferences measure from the seven points¹⁵.

A descriptive analysis was carried out as data frequency distribution for the sociodemographic characterization of the sample and also with reference to the kinds of surgeries and other treatments for breast cancer.

The contralateral limb was used as a normality parameter for the treated limb. To check the efficacy of this study, the first and last evaluation of the limb were compared, and was selected the statistical method for paired T and dependent variables. In all tests, the level of significance $\alpha=0.05$ was applied, and the sample met the normality standards.

RESULTS

Women had a mean age of 60.9±11.72 years, varying from 42 years to 85 years old; 70.6% women were white, 47% women were married, and only one woman had a professional activity besides housework.

Mean time, since surgery, was found to be 2.22±1.70 years, and the most frequent surgical techniques were modified radical mastectomy (35.3%) and quadrantectomy (35.3%); 64.7% of the volunteers had undergone chemotherapy and/or radiotherapy treatment and 52.9% volunteers used or were still using hormone therapy at data collection period.

Time from the appearance of the lymphedema until the evaluation date to begin the study was around 1.56±2.95 years, varying from 3 months to 6.5 years.

To analyze the efficacy of this study in reducing the lymphedema, the measures applied before and after the treatment protocol, were paired. Perimetry of each point of the ipsilateral limb at surgery, subtracted from that of the corresponding point of the contralat-

eral limb, provided the perimetry difference. Therefore, when the difference was above 2 cm, it was considered lymphedema¹⁵. The values thus obtained, demonstrated a significant reduction in three points (Table 1).

A mean 41.16 cm³ reduction, i.e., 13.8% (p=0.0089) of the volume difference (VD) between the limbs (Figure 1), and the volume increase percentage (VIP) of the limb with lymphedema compared to the contralateral

(VIP), also presented a significant reduction (p=0.0067) of around 14.1% (Figure 2).

Home exercises and self-massages were monitored on a weekly basis, and a mean frequency of 4.7±6.28 for self-massages and 9.0±8.4 for weekly exercises was also observed.

Table 1. Means of perimetry differences obtained from 17 women between the limb with lymphedema and the contralateral limb, achieved before (initial) and after (final) applying the protocol

Perimetry (cm)		Mean	SD	p-value
Point 1a	initial	0.92	0.81	0.0824
	final	0.53	1.14	
Point 2	initial	1.12	1.10	0.0674
	final	0.79	0.85	
Point 3	initial	2.15	0.88	0.0138*
	final	1.76	1.08	
Point 4c	initial	1.65	0.93	0.1375
	final	1.44	1.06	
Point 5	initial	1.62	1.14	0.0282*
	final	1.38	1.22	
Point 6	initial	1.85	1.3	0.2200
	final	1.71	1.1	
Point 7p	initial	0.79	0.97	0.0476*
	final	0.53	0.60	

SD: standard deviation; P: significance for the Student's t-test to paired samples; p* < 0.05; 1a: axilla; 4c: elbow; 7p: wrist

DISCUSSION

The main objective of the lymphedema treatment is to reduce volume, restore function, and improve physical appearance of the affected limb¹⁶. Although the limb function was not evaluated, this study showed that in the studied sample there was a reduction of the lymphedema, after using the proposed protocol.

The most important objective techniques to evaluate lymphedema include perimetry of the affected limb in different points and volumetric measures. Although volumetry has the aim of measuring irregular edemas like lymphedema¹⁷, perimetry, when performed carefully, supplements the evaluation as it shows the most affected sites, because the lymphedema is not homogeneous¹⁸. In this study, data from the perimetry enabled the mathematical calculation of the limb volume.

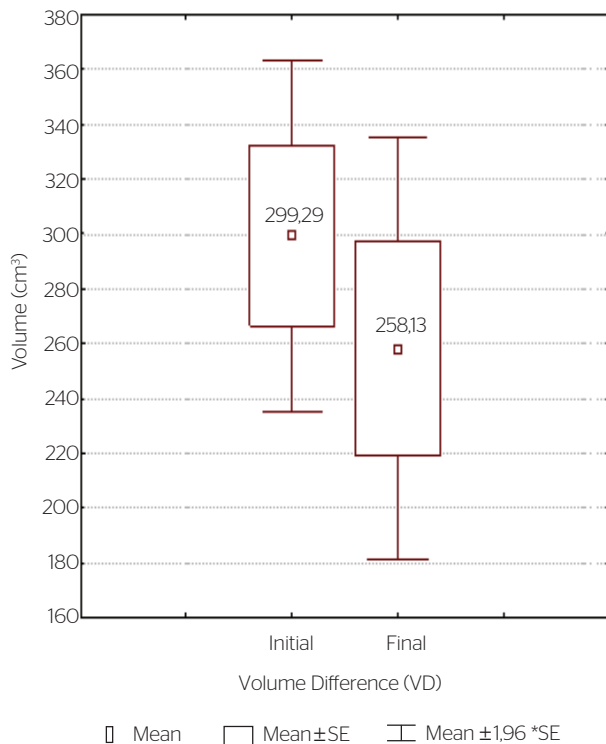


Figure 1. Volume difference (cm³) between the limbs before (initial) and after (final) the protocol use

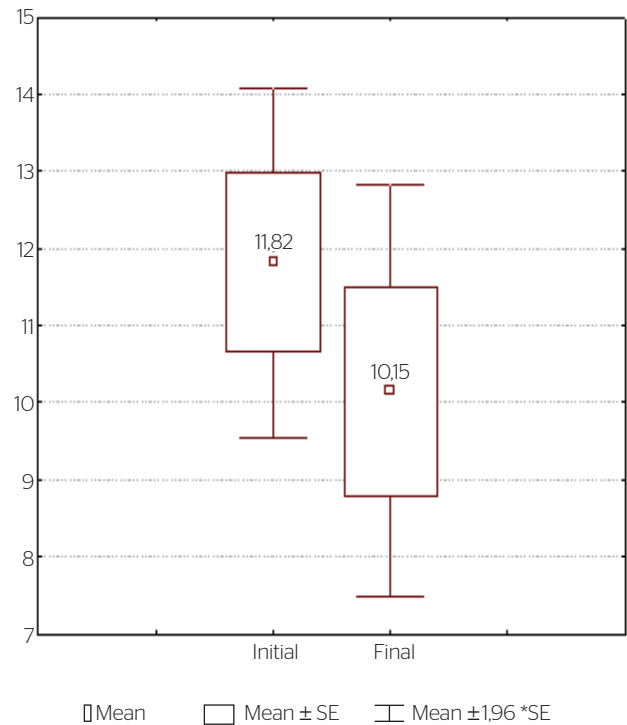


Figure 2. Volume increase percentage between limbs before (initial) and after (final) protocol use

A common alternative to estimate the limb volume consists of calculating circumference measures and volume through geometrical formulae. The cone formula represents the limb form in a better way. Sander et al.¹⁵, after measuring 50 women with upper limb lymphedema, observed good intra- and inter-evaluator reliabilities between water and geometrical volumes, with intra-class correlation coefficients equal to 0.91 and 0.99, respectively.

In the present study, perimetry and indirect volume were used (cut-off cone formula) for measuring the limbs. Furthermore, in both these measures, changes in the upper limb form were controlled when the contralateral limb was applied as a control of the treated limb. Changes induced from exercises or from the BMI can happen similarly in both the limbs¹⁹. Despite the fact that this method does not allow to know in which tissue the changes occur, regular exercises are associated with muscular hypertrophy and loss of the adipose tissue.

In the evaluation of each segment in the perimetry, it was possible to observe a significant reduction in the following three points: 7 cm above the elbow ($p=0.0138$), 7 cm below the elbow ($p=0.0282$), and at the wrist ($p=0.0476$). Even though it was non-significant, a decrease was also observed in the other points.

Another study stated a significant decrease only 6 cm below the ulna. The justification for such answer would be the irregular accumulation of the lymph. Therefore, the lymphedema justification could be provided both by a simple change in the circumference, or in the limb total volume²⁰.

The proposed protocol with HVES, exercises, and home guidance also provided a significant decrease of 13.8% ($p=0.0089$) of the VD (initial= 299.20 ± 135.32 cm³ and final= 258.13 ± 161.78 cm³) and of 14.1% ($p=0.0067$) from the VIP (initial= $11.82\pm 4.77\%$ and final= $10.15\pm 5.60\%$).

Garcia and Guirro¹¹ observed 15 women with unilateral lymphedema (mild to severe grades) in a study and used the same application parameters of HVES from this study. A significant reduction equivalent to 8.53% of the volume, between the 1st and 14th sessions (2.18 L ± 0.96 and 1.99 L ± 0.88) was found by Garcia and Guirro. The severity of the lymphedema also decreased 4.35% ($p<0.05$), according to data from the 1st ($28.63\%\pm 20.50$) and 14th sessions ($24.28\%\pm 19.57$). Results obtained in the present study are in agreement with these findings; however, they have more significant values, probably because of their association with other therapeutic resources. Besides the non-inclusion of women with severe lymphedema, provided an early intervention in a tissue less compromised by the chronic lymphedema (fibrosis presence)²⁰.

Because some statements about the use of HVES were reported in the already published scientific literature that declared the application of HVES in promoting an effect to reduce microcirculation permeability, decrease the size of capillary pores, and restrain protein movement to the interstitial space¹¹ associated with the act of bombing the skeletal and lymphatic smooth muscles (also caused by HVES)²¹, the use of HVES was made applicable in the protocol of this study. The effect of the use of HVES may have been the cause of lymphedema decrease.

The HVES parameters used in this study are in conformance with other studies that were used for reducing lymphedema. The effect of local cathodic stimulation to reduce vasa permeability for big molecules was reported in some studies^{21,22}. Griffin et al.²³ have also used cathodic HVES, because it seemed to produce a motor reaction with little discomfort.

HVES applied with 50 Hz frequency creates an increase in blood flow, which allows the quick removal of toxins and provides better contribution of oxygen²⁴. Based on these effects, Garcia, Guirro, and Montebello²⁰ have also used 50 Hz frequency in their study.

In this study, placement of electrodes in the forearm anterior region, recruiting flexor muscles, was carried out according to the anatomy of vases and drainage tracking, which were performed mainly by the antero-internal face of the forearm and arm^{8,20}. The principle, to avoid muscle fatigue when the voltage is high, the current must be modulated in such a way that the pulses should be released in an interrupted manner, in contraction (on) and rest (off) periods²⁵, was also applied.

The muscle bombing mechanism occurs not only with contractions induced by HVES, but also with the muscle voluntary contractions. Therefore, exercises also stimulate bombing, thus increasing the venous and lymphatic fluids. More specifically, they can also recruit sympathetic units, stimulating the contraction of the lymphatic vases¹⁹.

Moseley, Carati, and Piller²⁶ consider exercises and self-massage as a maintenance therapy and emphasize that, despite producing a small volume reduction, they have proved to be more beneficial compared with not performing any other accessible or economically viable treatment for the patient.

Performing home exercises and self-massages were monitored on a weekly basis, and a mean frequency of 4.7 ± 6.28 for self-massages and 9.0 ± 8.4 for exercises was also observed. This demonstrates an association of women to this kind of therapy. Similar observation was found by McKenzie and Kalda¹⁹, because many women, besides reporting improvement of the lymphedema limb, still continue the exercises even when the research work is completed.

Following were the limitations while performing this study: absence of a Control Group, and the use of a measure that is considered not much reliable as the perimetry, even if it was performed carefully, i.e., by only one evaluator and with the same instrument.

CONCLUSION

The results of this study allow us to conclude that the applied protocol, which includes HVES, exercises, self-massage, and guidance about limb care, was effective for reducing lymphedema in the studied population. New investigations are necessary to deepen such subject for future research.

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