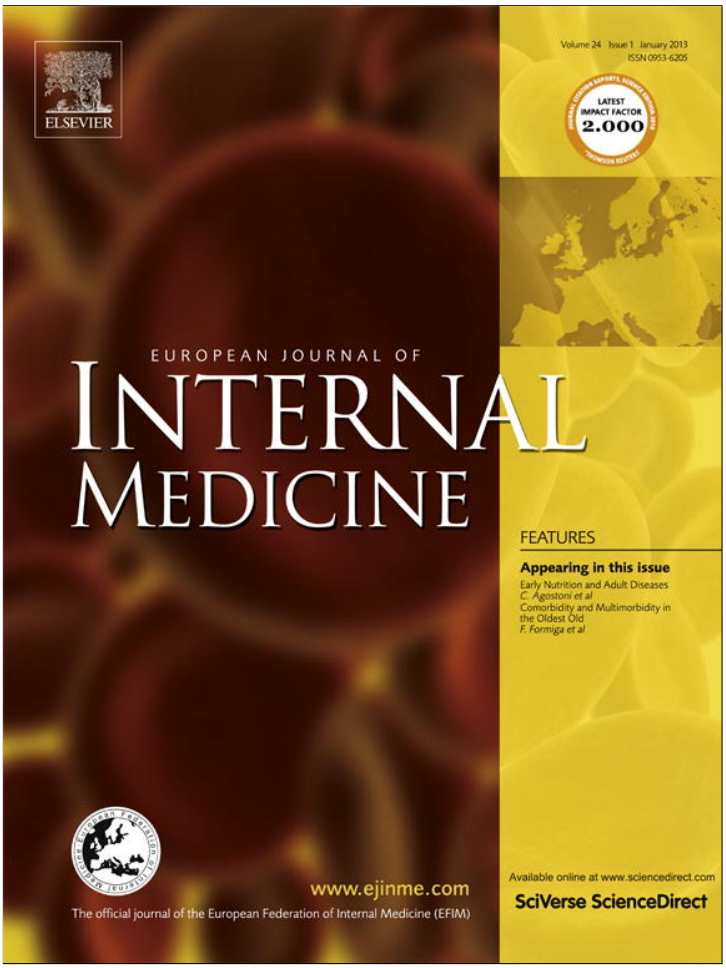

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Original article

Evaluation of a new approach to the treatment of lymphedema resulting from breast cancer therapy

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ABSTRACT

Purpose: The aim of this study was to evaluate a new form of intensive treatment for arm lymphedema.
Methods: A prospective study of 66 patients with breast cancer-related lymphedema was performed. The ages of the patients ranged from 35 to 83 years old with a mean of 58.8 years. Diagnosis of lymphedema was made by physical examination and water-displacement volumetry (a difference of ≥200 mL between arms). All the patients were submitted to clinical treatment in an outpatient setting which involved a once-weekly session of 3 to 4 h of manual and mechanical lymph drainage, myolymphokinetic activities and exercising using facilitating apparatuses and the use of a medical compression sleeve. Monthly volumetry evaluations were routinely performed. The Student *t*-test was employed for statistical analysis with an alpha level of 5% ($p<0.05$) being considered significant.
Results: The mean follow-up time between cancer treatment and this study was 12.3 months. A significant reduction in the size of the arms was observed for all patients. The mean difference between the lymphedematous and normal arms of all patients was 553.8 mL at the start of treatment and a mean reduction of 70.1% (388.7 mL) of the edema was achieved ($p=0.0001$).
Conclusion: In our experience, this model of treatment appeared efficacious in decreasing and maintaining the reduction in volume of arm in breast cancer-related lymphedema.

1. Introduction

The World Health Organization estimates that worldwide there are more than 1,050,000 new cases of breast cancer every year making this the commonest form of cancer in women [1]. In Brazil, about 49,240 new cases were estimated for 2010 [2]. Despite of the high incidence of this disease, the survival rate of women treated in the initial stages of the disease has been increasing. Data from GLOBOCAN 2008, the international agency for research on cancer, shows that breast cancer is the most common among women and represents 23% of all new cancer cases and 14% of deaths in this population [3]. About half of all cases of deaths occur in developing countries. Overall, incidence rates are high in Northern Europe, Australia, New Zealand and North America and intermediate in South America, the Caribbean, North Africa, southern Africa and Asia. Factors that contribute to the variation in incidence are largely due to differences in reproduction, hormonal factors and the availability of services for early detection.

The incidence in some countries such as the USA, UK, France, and Australia has diminished since the beginning of the millennium, not only partly due to less post menopausal hormone therapy [4] but also because of early detection by mammography and adequate treatment [5]. In many African and Asian countries, however, including Uganda, South Korea and India, incidence and mortality rates have been increasing with changes in reproductive patterns, physical inactivity and obesity; these are the main factors dealt with to improve awareness and for prevention [4,6].

One of the complications of breast cancer treatment is lymphedema which affects up to 50% of patients [4,7]. Lymphedema is characterized by a type of edema caused by an abnormal accumulation of fluids and other substances in the tissues resulting from failure of the lymphatic drainage system [5,6,8,9]. Currently there is concern in respect to sequels resulting from surgery and radiotherapy, as the limitations caused by lymphedema directly affect the quality of life of women [7,8,10,11].

Limitations include a reduction in joint mobility with decreases in the amplitude of movements, an increase in the weight of the arm and pain; many sufferers experience serious difficulties to perform daily tasks [9,12]. Psychological morbidity is also an important aspect as patients suffer from the moment they are told about the disease and during the entire treatment period and with the consequent sequels. Sequels that commonly develop in mastectomized women demand multidisciplinary care both in their prevention and treatment [10,13].

As there is no consensus on a single therapy to treat lymphedema, an association of methods is recommended [11,14]. Frequent evaluations are necessary in order to monitor the evolution of the patient and the application of the different techniques used. In spite of the association of several techniques in the treatment of lymphedema, there is still a need for safe alternatives that guarantee greater independence for these patients. A meta-analysis suggests that compression garments

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and compression bandaging are effective in reducing limb lymphedema volume in edema caused by several types of cancer. Specific to breast cancer, a statistically significant beneficial effect was found with the addition of manual lymph drainage to compression therapy to reduce upper extremity lymphedema volume [12,15].

The aim of this study was to evaluate a new form of intensive therapy with a single 3 to 4-h weekly session to treat breast cancer-related lymphedema.

2. Patients and method

A prospective study of 66 women with breast cancer-related lymphedema was performed in the Godoy Clinic in São José do Rio Preto, Brazil from March 2007 to December 2008 with an average follow-up time of 12.3 months. The ages of the patients ranged from 35 to 83 years old with a mean of 58.8 years. The diagnosis of lymphedema was made by physical evaluation and water-displacement volumetry (a difference of >200 mL between arms). All patients were submitted to total mastectomy, axillary lymph node dissection, chemotherapy and radiotherapy. Twenty-six percent of the patients had histories of cellulitis and/or erysipelas. Enrollment of patients was by consecutive invitations to all patients consulted in the clinic. The objective of the study was explained to candidates and those who chose to participate were required to sign an informed consent form. Patients in the advanced stage of the disease and those who did not wish to participate were excluded from the study.

All participants were submitted to clinical treatment which included a single 3- to 4-h weekly session in an outpatient setting involving: manual lymph drainage using the Godoy and Godoy technique [16–18], mechanical lymph drainage [19,20], myolymphokinetic exercises using facilitating apparatuses [21], and the use of a medical compression sleeve made from a cotton-polyester material [22,23]. Additionally, daily-life [24] and myolymphokinetic activities [25] were adapted, psychological and nutritional supports were provided and the compression sleeves were adjusted as necessary to extend treatment to the patients' home.

The Godoy and Godoy lymph drainage technique utilizes manual movements that follow the laws of hydrodynamics; pressure is exerted using the hand or another object such as rubber rollers, which slide over the skin following the course of the lymphatic vessels to the lymph node chains. The control of pressure (30 to 40 mm Hg is recommended) and speed of movements are subjective; however the movements should be slow, for example, the time spent to displace lymph between the elbow and the axillary region is about 3 min (this may vary during drainage). The technique begins with 20 min of cervical stimulation [24–27].

Myolymphokinetic exercises and activities are all muscle activities that cause pressure variations within the lymphatic vessels due to external compression of the vessels by the muscles. However, we consider myolymphokinetic activities to be therapeutic when there is a resulting reduction in the volume of lymphedema due to these activities.

Myolymphokinetic exercises using facilitating devices are activities in which a resistance-free apparatus is utilized to exercise the muscles, for example, flexion and stretching of the arm. It is important that these apparatuses require little effort as the energy used during exercising increases the blood flow to muscles and, generally, the therapeutic effect is reduced or lost. These apparatuses were developed to standardize, facilitate and evaluate movements. The working pressures of the main muscle groups were evaluated while using a compression mechanism and the exercise-facilitating apparatuses were designed based on the importance of these muscle groups.

All the patients were evaluated by water-displacement volumetry before and after 1 h of exercising using each of the apparatuses. Apparatuses that reduced the size of lymphedematous limbs of a specific patient were identified as the best exercise program for that patient (a single apparatus or several, exercising for 1 h continuously or with rest intervals every 15 min). Patients were given a choice of which apparatus they wanted to use but always taking into account the reduction in volume produced by each device. When the patients are in the clinic, they perform different activities in succession so that the professionals can complete the activity program with all patients.

Myolymphokinetic activities were individually evaluated and adapted for each patient by an occupational therapist. For example, the manner that a patient brushed the floor was studied so that the movements could be adapted to work as part of the treatment program. These activities were evaluated by water-displacement volumetry before and after each activity.

A medical compression sleeve, made of a textile composed of about 50% cotton and 50% polyester (*gorgurão*), was developed to substitute bandaging. This garment simplifies the use of compression mechanisms, making compression therapy at home more practical; almost all patients can dress and undress the garment by themselves or with the help of a relative without the need of professional assistance, thereby providing much more independence to the patient. Additionally it reduces the price of treatment for underprivileged populations. The development of this garment followed scientific norms and was evaluated in studies of tolerance and efficacy.

These low-stretch compression sleeves exert pressure both when the muscles are at rest and working. This cotton–polyester textile has lengthwise elasticity allowing flexibility of the limb; however across the textile (therapeutic function that generates the main working pressures in compression therapy) it has less than 50% elasticity (low-stretch compression).

Monthly volumetric evaluations were routinely performed. The Student *t*-test was employed for statistical analysis with an alpha level $\leq 5\%$ ($p<0.05$) being considered significant.

3. Results

A significant reduction in the volume of the lymphedematous arms was seen for all patients. Table 1 shows the ages, initial and final volumes of the arms and the number of months of treatment. The mean initial volume of the lymphedematous arms was 2223.3 mL and for normal arms it was 1664.3 mL giving a mean difference between the two limbs of 559 mL. The mean volume of the limbs after treatment was 1831.5 mL. A significant reduction ($p<0.0001$) of 70.1% (388.8 mL; 95% confidence interval: 324.8 to 452.7) was obtained using this treatment (Table 2 and Fig. 1). Two patients desisted due to family problems.

4. Discussion

This study describes a new multidisciplinary approach to treat breast cancer-related lymphedema using occupational therapy and compression as the main basis of treatment. No publications were found in the MEDLINE, OVID and Scopus electronic databases that utilize an approach similar to this. Thus it is difficult to compare these results with other studies. The intensive approach of 3 to 4 h weekly, allows a greater interaction between the treatment team and patients and also among the patients themselves. The volume of lymphedema was reduced in all patients and for more than 50% the difference in size between arms was within the normal range by the end of the treatment program.

Programmed evaluations are important to control the evolution of treatment. During the weekly assessments, a progressive reduction in volume was observed for all patients, however in some months, a small increase (generally less than 100 mL) compared to the previous month occurred for a few patients. These increases were normally lost in the subsequent month. These data show that the disease is not cured, but the clinical aspects of the patient have improved. Often patients aggravate the disease by not taking necessary precautions however the final result shows the efficacy of treatment in terms of lymphedema volume reductions.

The first phase in the creation of this treatment model was to create a compression arm sleeve which patients could easily dress and undress by themselves or with assistance of relatives or friends [22,23]. In this

Table 1
Ages, volumes of lymphedematous arms before and after treatment and the number of months of treatment of patients.

Patient #	Age (years)	IV (mL)	FV (mL)	Time (months)
1	58	1425	1173	21
2	53	2316	1670	19
3	68	1987	1594	15
4	78	1889	1596	17
5	62	2785	2031	22
6	64	2543	1920	11
7	65	3033	2538	22
8	58	2113	1863	18
9	46	2712	1879	21
10	72	2983	2487	19
11	50	1995	1743	19
12	48	1436	1392	6
13	47	2633	1696	21
14	72	2098	2068	8
15	54	2195	1472	18
16	56	1756	1456	16
17	74	2140	1888	21
18	58	3345	2632	22
19	33	1780	1534	15
20	38	1694	1596	9
21	61	3013	2019	21
22	72	2487	1676	15
23	74	1586	1348	10
24	58	1139	998	22
25	58	1438	1196	9
26	49	2564	2036	20
27	61	3378	2852	7
28	52	1745	1353	5
29	45	1928	1742	22
30	78	2594	1536	15
31	54	2048	1798	7
32	48	2668	2079	9
33	51	2738	2593	6
34	67	2978	2587	4
35	54	2396	1652	12
36	52	1800	1708	11
37	65	3100	2612	8
38	82	2597	2363	5
39	71	2679	2306	3
40	51	1663	1496	5
41	58	1680	1438	6
42	66	1964	1753	11
43	35	1689	1458	11
44	78	1946	1696	12
45	59	2613	1835	12
46	45	1613	1400	7
47	53	1689	1496	7
48	72	1978	1832	12
49	43	2443	2443	6
50	52	2667	1986	12
51	62	1498	1198	12
52	83	2298	1915	10
53	64	2208	2165	10
54	47	1976	1796	10
55	62	1630	1536	5
56	38	2938	2387	11
57	58	1436	1273	12
57	74	1978	1725	12
59	55	1848	1512	10
60	65	2885	2337	12
61	39	3022	2337	12
62	39	1625	1252	12
63	59	1827	1738	2
64	72	2001	1754	3
65	76	3326	2876	6
66	72	2889	2089	10
Mean	58.8	2228.2	1839.4	12.1

IV = volume before treatment; FV = volume after treatment.
Time = number of months of treatment.

development phase, a textile was found that provides low elasticity across the textile (<50%) and greater elasticity along its length. Compression sleeves were made of this material either by the patient, when they had experience in making clothes, or by a professional seamstress, but always under the guidance of a healthcare professional. The resting and working pressures and the reduction in the volume of the limb resulting from myolymphokinetic exercises and activities were evaluated in studies. This compression mechanism enables day-to-day working activities to be incorporated in the treatment program. The main activities performed by each patient in their occupation, such as brushing the floor for housewives, were identified and then the movements were adapted by an occupational therapist so that these activities could be used as part of the treatment of lymphedema. A study evaluating occupational activities associated with the use of a compression arm sleeve demonstrated that this association by itself can significantly reduce the size of the arm [14,22,23] and thus, patients constantly 'treat their own arms'.

Table 2
Mean reduction in volume during treatment and mean reduction per month.

Variable	N	Mean	St dev	SE Mean	95% CI	P-value
Reduction	66	388.8	260.1	32.0	342.8–452.7	p<0.0001
Reduction by time [a]	66	36.21	25.19	3.10	30.02–42.41	p<0.0001

[a] Mean reduction per month.

Therapeutic myolymphokinetic activities produce venous and lymphatic returns greater than arterial capillary filtration as is seen by the reduction in volume of limbs. The work of muscles demands a greater blood supply to the arterial capillaries, and so a greater volume of fluids enters the cell interstice. However, as movement of the muscles exerts external compression on the vessels creating pressure gradients, there is a greater flow of fluids to the venous and lymphatic capillaries thereby increasing venous and lymphatic drainage. Identifying the volume of fluid drained from the cell interstice is important in this treatment.

Myolymphokinetic activities are suitable for therapy programs as long as adjustments are made in respect to duration, velocity and the force required; an increase in the size of the limb can occur if patients exaggerate and so training is crucial. These patients require periodic clinical evaluations to make further adaptations when necessary. In the training phase, assessment of the arm volume before and after activities and exercising is vital in order to demonstrate to the patient the importance of the advice given by the coordinating team. This is because some patients believe that if they perform activities faster than recommended, the results will be better, which is not the case. This situation is demonstrated by increases in the size of the arm when activities are performed too fast. Thus, awareness of patients is crucial to show where the treatment becomes inefficacious.

Psychological support, both as group therapy and, when necessary, individual consultations, was essential. The psychologist applied a wide-ranging questionnaire to assess the patients (the results of which are being prepared for publication). A dietician developed diets not only for weight control but also for general nutritional guidance. A dressmaker participated in the group making adjustments to the compression sleeves, which is fundamental in this treatment. Hydrogymnastics had the

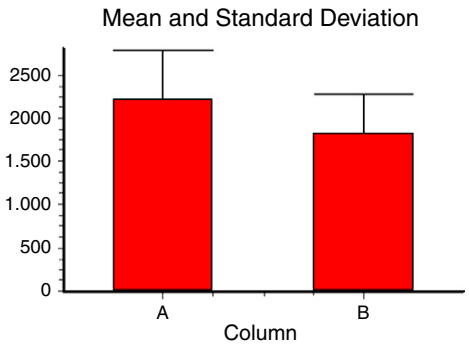

Fig. 1. Mean and standard deviation of the volume reductions of the arms.

objective of improving both the movement of the lymphedematous arm and the general physical fitness.

Lymph drainage was performed by a physiotherapist and an occupational therapist and occasionally by the physician himself. Complications should be evaluated and in cases of complications occurring at home, the patients must be told to treat immediately.

Occupational therapy permitted many patients to develop compression arm sleeves for their own use at home and even for sale as a source of income for their subsistence. An occupation makes patients feel more useful and independent. The relationships within the group created strong links among patients thereby providing support during difficult times hence socialization brought support and more self confidence to face problems.

Active and passive exercising helps patients understand the function of myolymphokinetic activities. The association of different activities maintained the stability of the group.

Several approaches to the treatment of breast cancer-related lymphedema have been reported with an association of treatments being most commonly utilized [28–30]. The limitations in the day-to-day life and quality of life of these patients is stressed [12,31]. Hence the identification of wide-ranging models that include all aspects affected by this disease is necessary.

5. Conclusion

In our experience, this model of treatment appeared efficacious in decreasing and maintaining the reduction in volume of arm in breast cancer-related lymphedema.

Learning point

- An intensive multidisciplinary treatment of lymphedema using new therapeutic approaches.

Conflict of interests

The authors state that they have no conflicts of interest.

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