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Effect of Manual Lymph Drainage on Upper Extremity Lymphedema in Breast Cancer Females

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Abstract: Breast cancer related lymphedema (BCRL), due to accumulation of lymph fluid in the tissues, as a result of surgical procedures and/or radiation therapy, is an important medical and socioeconomic problem that affects the quality of life. The most important symptoms are swelling, heaviness, numbness, limited motion and considerable disability. The aim of this study was to determine the effect of manual lymph drainage on upper extremity lymphedema in breast cancer females. Forty women with breast cancer related lymphyedema, their age ranged from 30-45 years old as it is the most common age of incedience of (BCRL), were assigned randomly into two equal groups. Group (A) (control group) treated by their regular medical treatment (venotonics and lymphotonics tab per 12 hours, anti-edematous 2 tabs per 8 hours) only, while group (B)(study group) treated by their regular medical treatment as in control group with the manual lymph drainage massage followed by compression therapy. Circumferential measurements along the hand, wrist, forearm and upper arm were taken at regular intervals(below styloid process by 4 cm and above it by 4 cm then mid way between styloid process and cupital fossa then below the cupital fossa by 4 cm and above it by 4 cm then mid way between cupital fossa and axilla then around the axilla), quality of performing ADLs were assessed before and after treatment through round measurements and upper extremity functional index (Paul Stratford scale), respectively. Statistical analysis revealed a significant reduction in the size of the affected limb and a significant increase in functional ability and mobility of the affected limb at post-treatment in compare to pre-treatment in the study group (B) (P-value = 0.0001). Comparing results of both groups post-treatment there was a highly significant reduction in the volume of the affected limb and a significant increase in functional ability and mobility of the affected limb for the favor of study group (B) than control group(A), while there was a statistically non-significant difference between the two groups at pre-treatment (P>0.05). Manual lymphatic drainage had a significant improvement on upper extremity lymphedema and functional disability in breast cancer females.

Key words: Manual lymphatic drainage · Unilateral lymphedema · Breast cancer · Compression therapy · Multi layer bandaging

INTRODUCTION

Breast Cancer Related Lymphedema is an abnormal accumulation of lymph fluid in the tissues on the affected side of the body following breast cancer treatment as a result of surgical procedures and/or radiation therapy so it is manifested by secondary lymphedema [1].

Secondary lymphedema is much more common than primary lymphedema and is caused by damage to the lymphatic transport capacity, e.g., by infection, trauma, surgery, radiotherapy or combination of these. There are suggestions that pre- existing factors in the lymphatic transport capacity determine whether one patient has a greater chance of developing lymphedema than another [2].

This study was done in trial to eliminate the incedince of BCRL as more than one in five women with breast cancer will develop breast cancer-related lymphedema (BCRL)as a result of breast cancer treatment [3, 4].

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BCRL is frequently encountered by breast cancer patients which in turn leads to poor functional recovery, chronic disability and impaired quality of life Mak *et al*. [5] Women with BCRL may suffer from psychological morbidity such as anxiety and depression, functional and physical impairment and diminished quality of life [6].

In addition to oral pharmaceuticals there are a varity of interventions that can be used for the management of (BCRL) In addition to oral pharmaceuticals [7]. They include compression garments or bandaging, manual lymphatic drainage (MLD), complex decongestive, or a combination of these modalities and advise for skin care [8].

The drainage of lymphatics by manual lymphatic drainage and applying compression may provide a significant reduction in lymphedema. Manual lymphatic drainage stimulates the contraction of lymph collectors while the lymph liquid is eliminated by the lymph nodule [9]. When we applied the bandage, an antagonistic force between the muscle and the bandage led to a pump effect and this facilitated lymph transportation [10].

The goals for conservative treatment are to eliminate edema by reducing interstitial fluid production and to stimulate lymphatic propulsion by compression. In addition, lymph flow is stimulated by manual lymph drainage (MLD), sometimes with additional presso-therapy to improve functional capacity. The combination of these therapeutic modalities is called decongestive lymphatic therapy (DLT). When the maximal therapeutic result is obtained, compression garments are then essential for long term management [8]. Therefore, the purpose of this study was to determine the effect of manual lymph drainage on upper extremity lymphedema in breast cancer females.

MATERIALS AND METHODS

Study Design: The study was designed as a prospective, randomized, controlled trial. Ethical approval was obtained from the institutional review board at Faculty of physical therapy, Cairo University before study commencement [No: P.T.REC/012/001955]. The study followed the Guidelines of Declaration of Helsinki on the conduct of human research. The study was conducted between May 2018 and November 2018.

Participants: Forty participants, selected randomly from Kasr AL-Ainy hospitals with breast cancer related lymphyedema as a result of breast cancer treatment (surgical procedures and radiation therapy). The inclusion criteria were evident breast cancer, even post mastectomy by one month up to 24 months with residual post-operative lymphedema or after radiotherapy with or without surgery. The participants age ranged from 30 to 45 years old and their body mass index (BMI) was 25 to 30 Kg/m^2. Participants with active stage of cancer or with acute disease, acute stage of inflammation (cellulitis, lymphangitis, erysipelas), acute deep venous thrombosis (DVT), Open wounds, active skin ulcers, dermatitis or cellulites, were excluded from the study.

Randomization: Each participant was informed about the nature, purpose and benefits of the study, the right to refuse or withdraw at any time and the confidentiality of any obtained data. The breast cancer related lymphedema women were randomly assigned into 2 groups equal in numbers (group A was the control and group B was the study group) with the use of a computer-based randomization program. No dropping out of subjects from the study was reported after randomization.

Interventions: Group (A) was composed of 20 breast cancer related lymphedema women who treated by their regular medical treatment (venotonics and lymphotonics tab per 12 hours, anti-edematous 2 tabs per 8 hours) only for 8 weeks. Group (B) consisted of 20 breast cancer related lymphedema women who treated by their regular medical treatment as in control group in combination with manual lymph drainage massage followed by compression therapy.for 8 weeks, (twenty-eight treatment sessions) started with two sessions per week for one month, then one session weekly for two months, then one session per two weeks for three months and finally one session monthly for remaining six months.

Evaluation Procedures: The following instruments were used:

Tape Measurement: Traditional tape divided to inches and centimetre up to 150 cm in length for round measurement of the affected arm.

Weight-Height Scale: Calculate the body mass index.

Upper Extremity Functional Index (UEFI): Weredeveloped by Paul Stratford and colleagues in 2001 to assces the functional ability of the affected arm.

Multi Layer Bandaging: Multilayer low-stretch bandaging which have limited extensibility is done immediately following manual lymph drainage to encourage the movement of congested lymph along the distal to proximal gradient created by bandaging .

Outcome Measures

Size of the Affected Limb: It was assessed for all breast cancer related lymphedema women in both groups (A & B), before and after treatment. Through measuring the circumferencial measurements in selected points taken in the same places every time at pre and post treatment along the affected limb by traditional tape as follows (below styloid process by 4 cm and above it by 4 cm then midway between styloid process and cupital fossa then below the cupital fossa by 4 cm and above it by 4 cm then midway between cupital fossa and axilla then around the axilla).

Upper Extremity Functional Disability Index: It was assessed for all breast cancer related lymphedema women in both groups (A & B). It measures the functional disabilities of the patients. Participants responded to a certain questionnaire composed of a 20 items with (0 indicates extreme difficulty and 4 indicates no difficulty performing the tasks). Therefore, maximum total score equal 80 points that was indicating maximum upper extremity functional disability.

Treatment Procedure: Each participant in control group (A) was instructed to take only their medical treatment (venotonics and lymphotonics tab per 12 hours, anti-edematous 2 tabs per 8 hours) regularly. These medications increase the number of macrophages and reduce vascular permeability. The increased number of macrophages causes proteolysis, resulting in the removal of protein that leads to a decrease in edema. The reduction of vascular permeability decreases the amount of edema in the interstitium.

Each participant in study group (B)was instructed to take their medical treatment regularly as in control group with following physical therapy program. They instructed to sit comfortably, well supported with arms supported on a pillow, while wearing light cotton clothes. Each participant underwent Manual lymphatic drainage (MLD) for (twenty-eight treatment sessions) (two sessions per week for one month, one session weekly for two months, one session per two weeks for three months and finally one session monthly for remaining six months by twelve months).

MLD always start with cervical lymph nodes and involve deep abdominal massage to the trunk to increase lymphocinetic activity, evacuate the physiological abdominal lymph load and activate the thoracic duct through deep abdominal breathing with pushing on the 5 points around the umbilicus, followed by light massage to clear lymphostasis in the proximal, middle and finally distal portions of the involved limb. MLD begins with treating the neck lymph nodes, preparation of the axillary lymph ipsilateral, as well as drainage of the lymph pathway in the abdominal skin.

Steps of Massage:

- Start with neck put second and third fingers just about the clavicle bone on either side of the neck, stretch the skin in inward motion using light pressure for 10 times.
- Then put the 2 hands flat on the sides of the neck with thumbs directed upward toward the ears and stretch the skin downward with light pressure in a slow, gentle, rhythmic manner (repeat for 10 times).
- Then massage the belly down towards the belly button start with the left upper portion of the abdomen then left lower, right lower and finally right upper and upper middle (repeat 5 times each), press the palms flat surface of the hand on stomach and then ask the patient to breath deeply through the nose allowing the stomach to expand then ask the patient to breath out slowly with pursed lips while the stomach is flattening (repeat 5 times).
- Gently pump the un affected underarm up toward patient's head and inward to the body (repeat 10 times)
- Gentle massage to the chest and stretch the skin from the affected side toward the non-affected underarm using light pressure (repeat 10 times).
- With the flat hand on the groin area of the affected side the pressure is directed to the belly with light pressure and gentle stretch to the skin (repeated 10 times).
- Then massage to the affected underarm below any scare to the groin using skin stretch technique (repeated 10 times).
- Then massage toward the neck and back of the shoulder (repeated 10 times).
- Gentle massage from inside to outside of the affected arm stretching the skin toward the back of shoulder (repeat 10 times), then outside and inside of the arm toward the upper arm, then massage the forearm.

- Then massage the back of the palm of the hand if fingers were swollen with gentle stretch motion toward the hand (repeat 10 times).

Multilayer low-stretch bandaging is done immediately following manual lymph drainage. Many layers of minimally elastic cotton bandages are used, beneath which layers of foam rubber padding are inserted to ensure uniform pressure distribution or to increase pressure in areas that are particularly fibrotic pressure within the short stretch bandages is cycling between low resting and high working pressures that creates an internal pump that encourages movement of congested lymph along the distal to proximal gradient created by bandaging. Enough padding must be applied to the sensitive areas of the elbow skin and over the bony prominent.

Meticulous hygiene is recommended to decrease dermal colonization with fungus and bacteria. Low pH moisturizers were applied to limit dermal desiccation and microbial growth. Because of impaired local immunity in a lymphedematous limb, breaks in the skin may allow entry of bacteria and result in serious infections [11].

Statistical Analysis: The Statistical Package for the Social Sciences (SPSS) computer program (version 22) was used for data analysis. Prior to final analysis, data were screened for normality assumption, homogeneity of variance and presence of extreme scores. Such exploration was done as a pre-requisite for parametric calculations of the analysis of difference and of relationship measures. Normality test of data using Shapiro-Wilk test revealed that the data was normally distributed for round measurement below wrist, just above wrist, mid forearm, below elbow, above elbow, mid arm and axillary. There was homogeneity of variances, as assessed by Levene's ($p > .05$) for dependent variables. Accordingly, 2x2 Mixed MANOVA test was used to compare round measurement below wrist, just above wrist, mid forearm, below elbow, above elbow, mid arm and axillary at different measuring periods at the two groups. While Normality test of data using Shapiro-Wilk test revealed that the data was normally distributed for function index. So, comparison between variables in the two groups was performed using Mann Whitney test. While comparison between pre- and post-treatment data in the same group was performed using Wilcoxon Sign Ranks test. The p-value ≤ 0.05 was considered significant.

RESULTS

Both groups were similar at baseline ($p>0.05$) regarding age, weight, height and BMI (Table 1).

Round Measurements

Within Group Comparison (Intra Group Comparison): In group A, there was no statistical significant difference between the mean value of all measured points (below styloid process by 4 cm and above it by 4 cm then mid way between styloid process and cupital fossa then below the cupital fossa by 4 cms and above it by 4 cm then mid way between cupital fossa and axilla then around the axilla) at pre-treatment and post-treatment .

In group B, there was a statistical significant decrease (p value < 0.05) in the mean value of all measured points at post-treatment when compared with its corresponding value measured at pre-treatment. The percent increase in group A was 0.23% while the percent decrease in group B was 12.83% (Table 2).

Between Groups Comparison: At pre-treatment, in groups A and B, the mean values (± SD) of all measured points had no statistical significant difference between the two groups.

AT post-treatment, there was a statistical significant decrease in the values of all measured points in group B when compared with their corresponding values in group A with $p< 0.05$ (Table 2).

Functional Index

Within Group Comparison (Intra Group Comparison): In group A, there was a statistical significant decrease (p value < 0.05) in the median value of functional index measured at post-treatment when compared with its corresponding value measured at pre-treatment. While in group B, there was a statistical significant increase (p value < 0.05) in the median value of functional index measured at post-treatment when compared with its corresponding value measured at pre-treatment (Table 3).

Between Groups Comparison (Inter Group Comparison): At pre-treatment, there was no statistical significant difference (p value > 0.05) between the median value of functional index in both groups. On the other hand, at post-treatment, there was a statistical significant increase (p value < 0.05) in the median value of functional index in group B when compared with its corresponding value in group A (Table 3).

Table 1: Demographic data of patients in both groups (A&B)

	Group A (n= 20)	Group B (n= 20)	t value	P value
Age (yrs.)	41.45±4.35	42.80±4.72	-0.061	0.951 (NS)
Weight (kg.)	76.75±6.50	77.30±4.64	0.461	0.647 (NS)
Height (m)	166.25±4.28	167.55±6.14	0.164	0.870 (NS)
BMI (kg/m^2)	27.76±1.92	27.57±1.72	0.395	0.694 (NS)

Data are expressed as mean ± SD. NS= p> 0.05= not significant.

Table 2: Comparison between mean values of the selected measure points on the affected upper limb in the two studied groups measured at pre- and post-treatment

Points of measurements	Group A (n= 20)	Group B (n=20)	P value
Below wrist			
Pre-treatment	25.83 ± 2.05	25.34 ± 2.25	0.471 (NS)
Post-treatment	25.89 ± 1.96	22.09 ± 2.05	0.001 (S)
% change	0.23 ↑↑	12.83 ↓↓	
p value	0.469 (NS)	0.001 (S)	
Just above wrist			
Pre-treatment	25.87 ± 2.21	25.02 ± 2.34	0.250 (NS)
Post-treatment	25.95 ± 2.05	22.46 ± 2.21	0.001 (S)
% change	0.31 ↑↑	10.23 ↓↓	
p value	0.319 (NS)	0.001 (S)	
Mid forearm			
Pre-treatment	31.17 ± 2.87	31.98 ± 2.53	0.352 (NS)
Post-treatment	31.33 ± 2.81	28.25 ± 2.11	0.001 (S)
% change	0.51 ↑↑	11.66 ↓↓	
p value	0.079 (NS)	0.001 (S)	
Below elbow			
Pre-treatment	34.22 ± 4.50	36.65 ± 3.39	0.061 (NS)
Post-treatment	34.30 ± 4.46	32.64 ± 2.49	0.001 (S)
% change	0.23 ↑↑	10.94 ↓↓	
p value	0.351 (NS)	0.001 (S)	
Above elbow			
Pre-treatment	37.22 ± 5.21	37.28 ± 3.08	0.965 (NS)
Post-treatment	36.27 ± 3.01	33.40 ± 2.67	0.001 (S)
Mean difference	0.95	3.88	
% change	2.55 ↑↑	10.41 ↓↓	
p value	0.366 (NS)	0.001 (S)	
Mid arm			
Pre-treatment	37.26 ± 2.81	38.48 ± 2.30	0.143 (NS)
Post-treatment	37.34 ± 2.85	34.93 ± 2.89	0.001 (S)
% change	0.21 ↑↑	9.23 ↓↓	
p value	0.382 (NS)	0.001 (S)	
Axillary			
Pre-treatment	37.75 ± 2.40	38.43 ± 3.31	0.459 (NS)
Post-treatment	37.78 ± 2.31	37.04 ± 2.79	0.001 (S)
Mean difference	0.03	1.39	
% change	0.08 ↑↑	3.62 ↓↓	
p value	0.683 (NS)	0.001 (S)	

Data are expressed as mean ± SD, S = P<0.05 = significant, NS= p> 0.05 = not significant.

Table 3: Intra and inter-group comparison between median values of functional index in the two studied groups measured pre- and post-treatment.

	Group A (n= 20)	Group B (n= 20)	Z# value	P value
Pre-treatment	33.0 (21.0-49.0)	31.0 (21.0-42.0)	-0.840	0.401 (NS)
Post-treatment	27.0 (20.0-47.0	52.5 (37.0-69.0)	-4.943	0.001 (S)
Z## value	-3.948	-3.920		
p value	0.001 (S)	0.001 (S)		

Data are expressed as median (minimum-maximum). NS= p> 0.05= not significant.

S= p< 0.05= significant.Z#= Mann Whitney test.Z##= Wilcoxon Sign Ranks test.

DISCUSSION

Breast cancer related lymphedema (BCRL) is an abnormal accumulation of lymph fluid in the tissues on the affected side of the body following breast cancer treatment as a result of surgical procedures and/or radiation therapy [1].

The results of the present study revealed that there was no significant difference in the round measurments and fuctional ability either within each group or between groups A & B at pre-treatment. Comparing both groups post-treatment revealed that there was a highly significant reduction in the round measurmentsof the affected arm as well as increase in functional ability in favor of group (B).

Fourie and Robb, [12] reported the case of a woman who developed AWS 22 days following axillary dissection. Physiotherapy with rotatory movements and stretching of the restricted tissue resulted in the achievement of premorbid ROM within 3 weeks. Furthermore, pain and visible cords had completely resolved after 16 weeks of therapy. As this case report, physical therapy can shorten the natural course of AWS by up to 3 months.

As Pressure within the short stretch bandages is low when patient is inactive, "resting pressure". Muscle contractions increase interstitial pressure, “working pressure”, as muscles expand within the limited volume of the semi-rigid bandages. Interstitial cycling between low resting and high working pressures creates an internal pump that encourages movement of congested lymph along the distal to proximal gradient created by bandaging. The non-elastic bandage sheath also counters refilling of fluid and reduces tissue fibrosis which further reduces volume [13].

Our results are in accordance with a previous meta-analysis McNeely *et al*. [14] which showed relative benefit ofthe addition of MLD in reducing BCRL, but two studiesof McNeely’s meta-analysis comparing different methodsof lymphatic drainage were wrongly incorporated.

Karadibak *et al*. [15] conducted a prospective trial of intensive decongestive physiotherapy for upper extremity lymphedema and showed decrease in edema, fear of activity and improved quality of life. To date, several studies have been published investigating the effects of CDT and MLD in preventing and treating post mastectomy lymphedema [24].

The results of our study was agreed with Badger *et al*. [8] which conducted a randomized clinical trial that tested physicaltherapies with a follow-up period of at least 6 months.They concluded wearing a compression sleeve is beneficial and bandage-plus hosiery resulted in a greater reduction in excess limb volume than hosiery alone.

Martin *et al*. [16] provided information on the effectiveness of MLD and its impact on the quality of life and physical limitations among PML patients.

Manual Lymph Drainage plus a compression garment use was compared with sequential pneumatic compression plus compression garment use; no difference was detected between the treatment groups (level II evidence) [25].

The results of our study was agreed with Szuba *et al*. [17] reported that the intermittent pneumatic compression pump has a significant effect on lymphedema. They performed a study with 23 patients who were randomly divided into two groups. The first group had therapy, including manual lymphatic drainage combined with the use of an intermittent pneumatic compression pump. The second group had therapy with only manual lymphatic drainage. At both the end of 2 weeks and 40 days, volume reductions were 45.3 and 30.3 %, respectively, in group 1. In group 2, at the end of 2 weeks and 40 days, volume reductions were 26 and 27.1 %, respectively. They reported that the addition of the intermittent pneumatic compression pump to standard CDT yielded an additional mean volume reduction.

The results of our study was agreed with Lacomba *et al.* [18] that showed a preventive effect of a combination of manual lymph drainage and exercise therapy on the development of lymphoedema. They included 120 patients after axillary dissection, although power calculation was performed retrospectively on the basis of an estimated cumulative incidence of 10% in the intervention group and 30% in the control group and a power of 70%. Patients were treated over three weeks. Within the first year after surgery, 7% of the patients in the intervention group, who received guidelines, exercise therapy and manual lymph drainage and 25% of the patients in the control group, who received only guidelines, had developed arm lymphoedema. All patients who developed arm lymphoedema did so 6-12 months after surgery.

The results of our study was agreed with Devoogdt *et al*. [19] evaluated the effect of MLD used in combination with exercise therapy and instructional guidelines for lymphedema prevention in 160 patients with breast cancer and unilateral axillary lymph-node dissection, who were stratified by body mass index and axillary irradiation. Patients received exercise therapy plus MLD or exercise therapy only for 6 months; the results showed no significant difference in the prevention of lymphedema between the two groups [19].

The results of our study was agreed with Josenhans [20] which demonstrated that symptom improvement including decreased pain, restoration of full shoulder ROM and increased shoulder function could be attained within six physical therapy sessions. In our study, physical therapy restored shoulder ROM and improved muscular strength in all patients

Compression reduces capillary filtration depending on the exerted pressure and the stiffness of the compression material. Material with low stiffness but higher pressure may achieve a reduction of capillary filtration rate to an extent similar to material with high stiffness but lower pressure [21].

Tissue fluid flow during manual stopped immediately after cessation of massage. In a recent study the same group demonstrated that radioactive tracer shifted by IPC did not cross the inguinal crease [22].

The drainage of lymphatics by manual lymphatic drainage and applying compression may provide a significant reduction in lymphedema. Manual lymphatic drainage stimulates the contraction of lymph collectors while thelymph liquid is eliminated by the lymph nodule [9]. When the authors applied the bandage, an antagonistic force between the muscle and the bandage led to a pump effect and this facilitated lymph transportation [10].

In another study which failed to support the use of MLD in treating BCRL [23], the authors included researches not only comparing the addition of MLD to ST but also MLD versus ST.

Most studies of physical therapy in breast cancer patients with AWS have been case reports. Nonetheless, these studies suggest that physical therapy is a quick and effective method to resolve shoulder disorders [24].

By contrast, Lacomba *et al*. [18] used MLD, scar-tissue massage and progressive active and action-assisted shoulder exercises postoperatively in patients who had undergone breast-cancer surgery, whereas their control group received only instructional guidelines for lymphedema prevention Lacomba *et al.* [18] found a significant difference in secondary lymphedema between the groups at 1-year post-surgery. However, the individual contribution of MLD to the prevention of secondary lymphedema was unclear.

The results our study was not agreed with Didem *et al*. [25] study, mobility measured by standard techniques of goniometry found no differences existed between groups, either. In Dayes *et al*. [26] study, no significant difference was found in arm function measured by DASH scale (Disabilities of the Arm, Shoulder and Hand) between groups.

Our findings support the study by Kepics [27] who recommended MLD, with a 15-20-mmHg compression sleeve if needed, for breast cancer patients with AWS who develop lymphedema.

CONCLUSION

Manual lymphatic drainage had significant improvement on upper extremity lymphedema in breast cancer females.

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