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Effects of Manual Lymphatic Drainage Massage Associated with Physical Exercise Program in Morphological-Functional Blood Pressure Parameters

Helio Franklin Rodrigues de Almeida[1], Leonardo Severo da Luz Neto[2], Fabrício Moraes der Almeida[3], Luiz Carlos Cavalcanti de Albuquerque[4], Paulo Fermiano da Silva[5] and Teresinha Cícera Teodora Viana[6]

[1]PhD in Physiology from the University of A Coruña, Spain Revalidation University of Brasília, Brazil, Master of Exercise Physiology - Federal University of Santa Maria, Brazil, Graduated in Physical Education – State University of Pará, Brazil. Professor of the Department of Collective Health, Researcher at the OBSAT and Researcher of GEISC of the Federal University of Rondonia, Brazil. Email: helio@unir.br

[2]Master in Education - Autonomous University of Barcelona, Master in Psychology - University of São Paulo. Master in Religious Studies – FAETEL, São Paulo. Bachelor of Nusring. Professional Physical Education. Bachelor in Theology. Researcher at the OBSAT, Researcher of GEITEC, Researcher of GEISC and Professor of the Department of Collective Health at the Federal University of Rondonia, Brazil. Email: lluz@unir.br

[3] PhD in Physics (UFC), with post-doctorate in Scientific Regional Development (DCR/CNPq). Researcher of the Doctoral and Master Program in Regional Development and Environment (PGDRA/UNIR). Leader of line 2 — Technological and Systemic Development, and Researcher of GEITEC — Federal University of Rondônia, Brazil. E-mail: dr.fabriciomoraes001@gmail.com

[4] PhD in Psychopedagogy from the University of Coruña, Spain. Bachelor in Psychology. Professor of Professional Orientation and General Psychology discipline and Researcher in OBSAT and GEISC of the Federal University of Rondônia, Brazil. E-mail: carlos_lula@hotmail.com

[5]Grupo de Estudos Interdisciplinares em Saúde Coletiva da UNIR.

[6]Master in Health Sciences by the Institute of Medical Assistance to the State Public Servant of São Paulo. Specialist in Family Health and Didactics of Higher Education. Bachelor of Nursing from the Faculty of Biomedical Sciences of Cacoal. Lecturer in the Nursing and Medicine Undergraduate Courses at the Faculty of Biomedical Sciences of Cacoal / Rondônia. Nurse at the Municipal Health Department of Cacoal (SEMUSA) and member of the Group of Interdisciplinary Studies in Collective Health of the Federal University of Rondônia. E-mail: teresinhaenfermeira@hotmail.com

***Abstract*— *The objective of this study was to investigate the effects of Manual Massage Lymphatic Drainage (MMLD) performed in association with an Aerobic Physical Exercise Program (APEP), in the arterial blood pressure (PSA) values of hypertensive subjects submitted to pharmacological treatment. The population of this study was composed of hypertensive subjects of both sexes and patients from SESI Clinic of the Municipality of Cacoal in Rondônia / RO, with the sample consisting of 28 subjects in the age group from 45 to 60 years and under pharmacological treatment to control hypertension arterial hypertension (SAH). Experimental Group 1 (GE1), composed of 14 individuals of both sexes (Age: 53.57 ± 7.20, Body Weight: 74, 15 ± 15.85, height: 166.1 ± 61), which during 8 weeks were submitted weekly on alternate days, to three MMLD sessions in parallel to a APEP with intensity controlled by the subjective sensation of effort; and b) An Experimental Group 2 (GE2), also composed of 14 subjects of both sexes (Age: 53.57 ± 7.20; Body Weight: 74.15 ± 15.85; Height: 166.1 ± 61); which during 8 weeks were also submitted to three weekly sessions of the same MMLD maneuvers applied in GE1, but were not submitted to PEFA. At the end of the procedures the statistical analysis allowed to observe that the PASS scores presented by GE1 and GE2, both indicated the same statistical significance (p = 0,000), with mean values being reduced by 8.1 mmHg for GE1 and 6,5 mmHg for GE2, representing a functional* *improvement of 6.3% and 4.9%, respectively. A similar behavior was found when analyzing the values of PASD, which at the end of the experimental procedure presented similar results for both study groups, statistical significance at the level of p< 0,05. Mean values were reduced by 5.5 mmHg for GE1, and 3.8 mmHg for GE2, representing a functional improvement of 6.3% and 4.3%, respectively. It is also observed that the results of the GE1 are higher than those of the GE2, and this can be attributed to the realization of the MMLD in parallel to the APEP, which seems to have potentiated the effects presented by the GE1. The results found in this research suggest that Manual Lymphatic Drainage Massage may be a valuable nonpharmacological auxiliary therapy in the control of arterial hypertension, also indicating that when performed in association with a regular program of aerobic physical exercises, it significantly increases the reduction of values blood pressure of hypertensive subjects.*

Keywords— Hypertension, Manual Lymphatic Drainage Massage, Physical Exercise.

I. INTRODUCTION

Manual Lymphatic Drainage Massage (MLDM) is the way to drain the cell interstitial and lymphatic vessels by massaging specific techniques performed without significant injury to the body's muscular tissues, which increase the production and movement of the lymph within the cell interstice, causing the content present inside the lymphatic vessels to circulate more rapidly. Thus, the gas and nutritional changes inside the cell are facilitated, as a result of the greater blood supply inside the cell, as well as the elimination of catabolics due to cellular catabolism (DA SILVA, 2004).

MLDM is used for therapeutic, aesthetic and even muscle relaxation purposes and is universally recognized for its vascular benefits, since its maneuvers stimulate the physiology of the blood circulation and the autonomic nervous system, providing acute relief to muscle stress in general (SINGI , 2004).

In this aspect it is known that the production of lymph in the human organism occurs whenever the cell interstice gets a very large load of toxins due to the metabolic chemical reactions, or when it receives an adverse external pressure and opens to the lymphatic capillary, promoting the emptying of the interstitial fluid and forming new lymph. Once produced, the lymph is transported via specific capillaries to the lymphatic vessels, whereby larger ducts carry it into the subclavicular veins carrying with it the remnants of the chemical reactions resulting from cellular catabolism, whose weight or molecular size is very large and does not can flow through a venule (SINGI, 2001).

In this way the lymph goes out through specific capillaries passing through ganglionic chains, its macro-molecules being phagocytosed with the purified lymph returning to the venous blood before reaching the heart. Considering that such macro-molecules are formed by proteins, toxins, salts, hormones and lymphocytes that participate in the organic defense in the ganglionic chain, it is assumed that lymph has as basic function to defend and to clean the cellular interstice (BALESTRO, 2002).

It is understood that MLDM can be a valuable aiding tool in this venous and lymphatic return mechanism, since contrary to the cardio-circulatory system in which the heart functions as a contractile-propelling pump pushing blood through the blood vessels, the lymphatic system does not own this property. Thus, for lymph to circulate like blood, MLDM's technical maneuvers exert gentle pressure on muscle tissues without reaching deeper anatomical structures, accelerating the return of lymphatic fluid to the heart, thus stimulating the elimination of toxins, even substances derived from infections, inflammations, muscle spasms and other similar processes (BALESTRO, 2002; DA SILVA, 2004).

The lymphatic system extends throughout the body in the form of a network, beginning with the lymphatic capillaries that converge to form the prefrontal collectors (afferent vessels). Several of these collectors go to the lymph nodes and form the lymphatic trunks, which will make up the lymphatic ducts forming the vessels of the final portion of the lymphatic drainage, which in turn lead to the venous system (SINGI, 2001).

For AIRES (1999), the lymphatic system is an important auxiliary of the venous system, whose function is to complete the extravascular circulation of fluids and proteins, thus ensuring homeostasis and tissue volume, causing approximately 50% of plasma proteins to return to the system circulatory. The concentration of these proteins varies from region to region and depends on aspects such as: a) The coefficient of vasoconstriction of exchange vessels in each tissue cell; b) The size of the molecules transported; c) The individual charge of each protein; and d) Capillary filtration rate.

Still AIRES (1999) suggests that there are about 10 to 12 liters of fluid in the interstitial space of an adult subject, which acts as a reservoir for the plasma compartment. If this volume of fluid is increased by urinary retention or infusion, the excess can pass into the interstitium, increasing its volume and space consequently increasing the interstitial pressure, a process technically called "edema", which once established has as a consequence retardation in the gas and nutritional exchanges that occur physiologically between the cells and the blood plasma.

For the aforementioned author, the subcutaneous tissues are extremely favorable to the appearance of edemas,

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which are caused by heart failure of the right ventricle, and are not clinically detected until the interstitial volume has increased above 100%, possibly due to the deficiency in cellular nutrition, cause some complications in the body as: skin ulceration, discomfort and difficulty of locomotion, among others.

On the subject in question, it is known that edema develops when the rate of capillary filtration exceeds the lymphatic drainage rate for a certain period. That is, the pathogenesis of edema involves an increase in filtration rate or decrease in lymphatic flow caused by capillary pressure, which is secondary to venous pressure caused by ventricular failure, which in turn increases post capillary resistance and may lead to dysfunction of the venous valves and consequently increase the pressure in both the venous capillaries of the skin and limbs, around 20 to 40 mmhg (AIRES 1999; Da Silva, 2004).

According to the aforementioned authors, another cause for the genesis of edema is the formation of inflammatory processes, which alter the properties of the capillary walls causing an increase in the hydraulic conductance and the selective permeability to the proteins, thus facilitating the development of edema. Considering that these two elements (fluid and protein) pass into the interstitial space, the only way of removing them from said site is through the lymph, where proteins that have not flowed into the venous return can return to the blood plasma, called lymphoedema.

This situation causes a fibrotic / greasy growth causing congestion of the capillary network, having as consequences: a) increase of the filtration pressure; b) arteriolar dilatation; c) venular constriction; d) increased venous pressure; e) heart failure; f) incompetent valves; g) venous obstruction; h) increase in the total volume of the extracellular fluid; and i) reduction of osmotic pressure through the capillary network (AIRES 1999).

Congestion in the capillary network increases the hydrostatic blood pressure (PHS), which leads to excessive movement of fluids into the interstitial spaces. Similarly, high blood pressure within the veins may cause an increase in PHS within the capillaries and allow the formation of edema. Conversely, improvement in venous blood flow reduces blood pressure, which in turn lowers PHS and avoids or decreases edema (AIRES, 1999).

In this sense, AIRES (1999) adds that the addition or subtraction of the effect of gravity on PHS, makes the arterial blood pressure (PSA) greater than the pressure in the tissues that surround them. Homeostasis of body fluid volume and PSA regulation are closely related via the mechanism of feedback of kidneys / body fluids, with the central component of this mechanism being the effect of PSA on the renal excretion of sodium and water, a phenomenon known as the mechanism of pressure / natriuresis / diuresis, which allows PSA maintenance to be achieved in the long term. The abnormality of this mechanism can cause disturbances in the level of PSA, which is the pressure exerted by the blood inside the blood vessels as a function of the systole and diastole of the heart, that is, the contraction and relaxation of the cardiac muscle and the vascular resistance opposite to the blood flow (ALMEIDA, 2003).

According to some authors, the high values of PSA constitute a phenomenon academically known as Blood Hypertension (SAH), and this is one of the main factors for the occurrence of cardiovascular diseases in human populations in general. This fact, according to epidemiological data, has been, for a long time and now more than ever, a global public health problem, with millions of people around the world presenting high PSA values (PITANGA, 1999, ALMEIDA et al., 2018) .

For Shoji and Forjaz (2000), control of this pathology can be done through pharmacological and non-pharmacological treatments, and drug therapy is indicated for moderate / severe hypertensive patients, and for those with risk factors for cardiovascular diseases and / or significant lesion of target organs, and despite its proven efficacy in reducing PSA values, it is necessary to consider its high cost and possible side effects.

On the subject, Da Silva (2004) has published non-pharmacological interventions such as alcohol restriction, smoking cessation and regular physical activity, as they promote changes in personal lifestyle to prevent or halt the evolution of SA, have been reported for their effectiveness, low cost and minimal risk, and Pitanga (1999) reports the latter, the regular practice of physical activities, as currently the main prophylactic tool against such pathology.

Martin, Dubbert & Cushman (1990) further corroborate and affirm that the incidence and severity of SAH is inversely related to physical fitness levels, as well as that many studies confirm the reduction of PSA in subjects who are part of regular aerobic exercise programs , to which Almeida et alli (2018) attribute to occur due to the sympathetic neural reduction, which decreases basal sympathetic tone and contributes to improving SAH.

These statements do not necessarily constitute academic novelties on the subject, with several studies already demonstrating at some time the effectiveness of physical activity in reducing PSA levels (HAGBERG, 1988; OSIECKI, 1996; PITANGA, 1999; ROBERGS & ROBERTS, 2009 (1998), in which all of the data are presented in this paper.

On this subject, Almeida (2003) warns of the importance of detailed planning of the practice of physical activity, showing four basic aspects during its execution: intensity or quality, volume or duration, frequency and repetition

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of the stimuli. In this view, Almeida et alli (2018) suggest that an optimized state of an individual's systemic organic functional condition will only be achieved when the variables mentioned above are adequately planned, and wrapped in a scientifically methodalized work system regarding the prescription and control of training loads, what the author calls "physical exercise".

In view of the above, and considering that hypertension is a relevant risk factor for cardiovascular complications that may lead to death (BRANDÃO et al., 2003), this study intends to collaborate in the development of non-drug strategies that are shown efficient in the therapy of such pathology, investigating the effects of Manual Lymphatic Drainage Massage (MLDM) performed in parallel with an aerobic physical exercise program (PEFA), in the PSA values of hypertensive subjects and submitted to pharmacological treatment.

II. MATERIAL AND METHODS

2.1. Population and sample

The population of this study was composed of hypertensive subjects of both sexes and patients from SESI Clinic of the Municipality of Cacoal in Rondônia / RO, with the sample consisting of 28 subjects in the age group from 45 to 60 years and under pharmacological treatment to control hypertension arterial blood.

Initially, a first personal contact was made with the aforementioned institution, and the nature and relevance of the research was explained at the time, as well as authorization for the study. Subsequently a lecture was given to the subjects interested in voluntarily participating in the experiment, explaining details about the subject to be investigated, and informed at the time that individuals who were absent from any PEFA session would be excluded from the study.

Finally, after identifying the subjects with vascular risk (cardiac failure, thrombosis and decompensated hypertension), or even under chemotherapeutic treatment, two experimental groups were randomly structured to develop the study:

a) Experimental Group 1 (GE1), consisting of 14 individuals, 7 men and 7 women, who during 8 weeks underwent 3 sessions of MLDM every other day, which were organized in a way not to hinder their daily activities. Thus, 6 subjects performed 1 session on Monday, another on Wednesday and the last one on Friday, with the other participants performing the sessions on different days (Tuesday, Thursday and Saturday), all of which were performed between 06:00 and 08:00 in the morning. On the same days of the MLDM sessions, during the night time between 7:00 p.m. and 8:00 p.m., the same subjects also performed three sessions of a PEFA; and

b) Experimental Group 2 (GE2), also composed of 14 subjects, 7 men and 7 women, who during 8 weeks were also submitted to three weekly sessions of the same MLDM maneuvers applied in GE1, only on different days Tuesdays, Thursdays and Saturdays), which are held during the night between 7:00 p.m. and 8:00 p.m., but are not subject to PEFA.

In order to avoid possible failures during the experimental procedure, the MLDM maneuvers were performed by massage therapists, and both in the data collection of the dependent variables and in the application of the PEFA, there were academics of the Physical Education Undergraduate course of the Faculty of Medical Sciences of Cacoal / RO,

2.2. Analysis variables, equipment and standardization of measurements

In this study, the anthropometric parameters were measured: a) Total Body Weight (PCT); and b) Stature (EST), used here only to characterize the sample. Then, the arterial blood pressure (PSA) measurement was performed, which represents the dependent variable of this study. The following equipments and standards are used for this purpose:

a) The PCT, which was accepted as the amount of body structure matter expressed in kilograms (kg), was measured using a Filizola brand electronic scale, with a capacity of up to 150 kg and a precision of 1g. The measurement was performed with the equipment positioned on level ground, being evaluated standing in the center of the platform, in an upright posture and with backs to the measurement scale, with the horizontal head, the legs slightly distant lateral and the arms relaxed to the length of the body (PITANGA, 2000);

b) The EST, understood as the vertical linear length between the plantar region and the vertex (highest point of the head), expressed in centimeters (cm), was measured using a portable stadiometer of the Avanutri brand and with a precision of 1mm. The measure was obtained with the subject barefoot, the heels, buttocks, the shoulder girdle and the occipital in discreet contact with the perpendicular ruler. According to standardization, a transverse slider was slid by the ruler to the support at the vertex at a right angle. The reading was performed with the maximum inspiration and head directed to the Frankfurt plane (PETROSKI, 1999); and

c) The PSA, understood as being the force with which the blood is released inside the arteries, and its values expressed in mmHg, was measured using a HEIDJI stethoscope, model Dusonic, and also 2 sphygmomanometers of the brand HEIDJI, aneroid model, 1 for individuals with arm circumference measuring 27 to 34 cm and another for subjects with measurement in said segment between 35 and 44 cm. For the measurement, evaluating him before physical activity and without having ingested caffeine in the last 60 minutes, he was seated for 5 minutes with his back straight and supported, his left forearm in semi-extension, his hand open and relaxed, both on a table of adjustable height and the left arm completely naked at the height of the precordial region.

In order to perform the measurement the evaluator positioned the sphygmomanometer occluder cuff on the left brachial artery closing the valve of the pump of inflation, and with the index and middle fingers united palpated the brachial artery to feel the cardiac pulse. Then he inflated the occlusive cuff until he could no longer feel his heart beat, then he placed the ear-cup of the stethoscope in his ears with the olives facing forward.

Finally, he placed the instrument bell in the antecubital fossa about 2.5 cm from the elbow fold over the brachial artery, and gently opened the air control valve by reducing the cuff pressure. The first and last sounds heard corresponded to the systolic and diastolic components of the PSA, respectively. Two measurements were taken at intervals of 60 seconds between them, adopting the lowest measured value as the final result, which was corrected by the arm circumference evaluating, this measurement is performed at the meso-humeral point of the left arm. (MION, SILVA & MARCONDES, 1986).

2.3. Treatment of study-independent variables

a) The Aerobic Physical Exercise Program (PEFA)

The PEFA was composed of physical training sessions with a total duration of 60 minutes each, being divided pedagogically as follows:

1) Preparatory Part: Total duration of 10 minutes, the initial 3 used to activate the blood circulation and to increase irrigation in the muscular tissues in general, using a continuous dynamic stimulus, performed in the form of moderate walking. The remaining 7 minutes were used to lengthen the muscle groups to be most requested in the sequence of physical activity, and for this purpose stagnant exercises were actively located, in which the individuals were in search of the limit of joint mobility in the anteroposterior, (Nunes, 1998), which is the most common type of joint in the joint, and is the most commonly used joint in the articulation of the wrist, elbow, shoulder, hip, knees and ankle. .

2) Main: With a duration of 40 minutes, it aimed to promote functional improvements in the cardiovascular system. For this purpose, a continuous type dynamic stimulus performed as a vigorous walk was used, and the intensity of physical activity was controlled by the subjective sensation of fatigue (ACSM, 1995; Almeida et alli, 2018). During the physical exertion of the walk the subjects placed the perception of fatigue in the first week of work at level 6 (moderate), which progressed weekly in a unit until reaching level 8, remaining in this for 4 weeks, reaching level nine 9) - strong from the seventh week of training and holding it until the end of the experiment.

3) Final part: With duration of 10 minutes, the first 3 intended to promote the physiological return of the subject to the initial levels of the training session. A continuous type dynamic stimulus performed in the form of a gentle walk was used. The remaining 7 minutes were used to lengthen the most requested muscle groups during the training, using the same methodology and the same exercises prescribed in the preparatory part.

b) The technical maneuvers of Manual Lymphatic Drainage Massage (MLDM)

The MLDM sessions were individual and had a total duration of 45 minutes each, the maneuvers consisting of linear movements invariably performed in the direction of the inguinal and axillary lymph nodes (GODOY & GODOY, 2004), with three repetitions sequenced in the region of the lower limbs, upper limbs, abdomen and posterior of the trunk, with the subjects in ventral or dorsal decubitus, according to the requirement of the body area to be massaged.

To perform the maneuvers, a massage table TMDMB model, manufactured by TANDER equipment, measuring 186 x 68 cm and designed in solid wood with a reclining headrest, rubber-lined feet, padded with 5 cm thick foam and coated in varvinised varnish, also having adjustable height between 60 and 80 cm and capacity to withstand up to 250 kg.

2.4. Statistical analysis

In this experiment the data were analyzed through the following procedures: a) the descriptive statistics were initially performed to characterize the sample, and later, in order to detect possible significant differences between the GE1 and GE2 scores, Student's t-test for independent samples; and b) Finally, to compare the PSA values in the pre and post-test of the experimental period, the Student's t-test for dependent samples was used.

Data were processed and analyzed using the Statistica for windows version 4.3 software package from Starsoft Incorporation, with a significance level of $p < 0.05$.

III. RESULTS AND DISCUSSION

In order to characterize the sample, the analysis of Student's t-test for independent samples of the mean values and their respective standard deviations of the variables: Age (ID), height (EST) and total body weight (PCT) of GE1 and GE2 at the beginning of the experiment. The statistical treatment showed significant differences between the scores of the variables: EST ($p = 0.04$) and PCT ($p = 0.03$), demonstrating the heterogeneity of the sample.

Table.1: Physical characteristics of the sample

VARIÁVEIS	GRUPOS EXPERIMENTAIS			
	GE1	GE2	t	P
PCT (Kg)	74,15 ± 5,85	69,47 ± 5,34	2,20	0,03*
EST (cm)	166,1 ± 5,61	171,1 ± 6,50	-2,13	0,04*
IDADE (anos)	53,57 ± 7,30	52,40 ± 7,36	0,41	0,68

* Significant at p <0.05 level

In accordance with the objectives of this study, Table 2 presents the analysis of the Student's t-test for samples dependent on the mean values and their respective standard deviations of the following variables: Systolic Blood Pressure (PSAS) and Diastolic Blood Pressure (PSAD) of GE1 and GE2 at the beginning and end of the experiment.

Table.2: Values of arterial blood pressure components of GE1 and GE2, pre and post-test.

GRUPOS DE ESTUDO	PRESSÃO SANGUÍNEA ARTERIAL SÍSTÓLICA – PSAS - valores em mmHg -				PRESSÃO SANGUÍNEA ARTERIAL DIASTÓLICA – PSAD - valores em mmHg -			
	PRÉ TESTE	PÓS TESTE	t	P	PRÉ TESTE	PÓS TESTE	t	P
GE1	128,2 ± 3,82	120,1 ± 0,39	16,19	0,000*	86,4 ± 1,91	80.9 ± 1.38	20,19	0,000*
GE2	132.4 ± 6,36	125,9 ± 5,31	10,51	0,000*	86,6 ± 3,88	82,8 ± 3,26	2,73	0,017*

* Significant at the indicated level.

When analyzing this table, it is observed that between the beginning and the end of the experiment the PSAS scores presented by GE1 and GE2 both indicated the same statistical significance (p = 0.000), and their mean values were reduced by 8, 1 mmHg for GE1 and 6.5 mmHg for GE2, representing a functional improvement of 6.3% and 4.9%, respectively.

A similar behavior was found when PSAD values were observed, which at the end of the experimental procedure indicated statistically significant differences for both study groups at the p <0.05 level between pre and post tests, with their mean values being reduced in 5.5 mmHg for GE1, which performed the PEFA in parallel with the MLDM, and in 3.8 mmHg for the GE2, which performed only the MLDM, representing a functional improvement in the levels of SAH in 6.3% and 4.3 %, respectively.

The results found in this experiment in relation to the PEFA to which the experimental groups were submitted are similar to those of other studies in the sense of corroborating the existence of positive correlations between the reduction of the arterial blood pressure levels of hypertensive subjects and the improvement of the physical condition resulting from such improvement, it seems, in the regular practice of physical exercises, especially when performed aerobically.

In this sense, Almeida et alli (2018) observed after 8 weeks of physical exercises performed in 3 weekly sessions at an intensity between 6 and 9 of the subjective sensation of physical exertion, a reduction of 6.5% and 4.0 for blood pressures systolic and diastolic, respectively. Seals and Hagberg (1984) reviewed 12 studies with different methodologies and concluded that the reduction of arterial blood pressure was between 6 and 15% for systolic and between 6 and 14% for diastolic, similar values to those found in this study. In addition, ACSM (1993), corroborating with other studies (Martine, Dubbert & Cushman, 1990, Eemon, 1995, Nieman 1999, Almeida et alli, 2018) showed a mean reduction of 10 mmHg in arterial blood pressure in subjects who practice regularly aerobic exercises.

Finally, analyzing the scores of the groups studied, it is observed that even though both are statistically significant in terms of improvement (p <0.05), the results of the GE1 are significantly higher than those of the GE2, and this fact can be attributed to the achievement of MLDM in parallel to the PEFA, a fact that seems to have potentiated the effects presented by GE1 in relation to the GE2, thus attesting the positive effect of the same.

IV. CONCLUSIONS

The results found in this research suggest that Manual Lymphatic Drainage Massage may be a valuable non-pharmacological auxiliary therapy in the control of arterial hypertension, also indicating that when performed in association with a regular program of aerobic dynamic physical exercises, it significantly increases the reduction of values of blood pressure of hypertensive subjects.

Thus, considering the existence of several gaps in this study, and still being a research that focuses on a subject that is lacking in more academic investigations, it is believed to have contributed with the scientific community in another option for non-pharmacological control therapy of arterial hypertension. In view of these findings, it is suggested to carry out new studies with a larger sample and to use new experimental designs, in addition to ratifying the results of this research, also extend this line of research.

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