Lymphology 41 (2008) 161-166

COMPLEX DECONGESTIVE PHYSIOTHERAPY DECREASES CAPILLARY FRAGILITY IN LIPEDEMA

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ABSTRACT

Lipedema is a disproportional obesity featuring frequent hematoma formation due to even minor traumatic injuries. On the basis of clinical observations, complete decongestive physiotherapy diminishes the incidence of hematomas due to minor injuries beyond leg volume reduction. Hematoma development may be caused by altered capillary resistance (CR) or altered capillary fragility (CF). We measured capillary fragility (CF) before and after complex decongestive physiotherapy (CDP) to examine, whether CDP could reduce CF. 38 women with lipedema were included in the study. Twenty-one (21) patients were treated with CDP and 17 using exclusively moisturizers as the control group. CDP comprised once daily manual lymph drainage, intermittent pneumatic compression and multilayered short-stretch bandaging performed throughout a 5-day-course. CF was evaluated with the vacuum suction method (VSM) using Parrot's angiosterrometer in both groups. Decongestive therapy resulted in a significant reduction of the number of petechiae while no change was detected within the control group. Complete decongestive physiotherapy significantly reduced CF in patients with lipedema and this reduction may lead to reduced hematoma formation.

Keywords: lipedema, complex decongestive physiotherapy, capillary resistance, capillary fragility, angiosterrometry

Lipedema is a distinct clinical entity that was first described by Allen and Hines (1). It is a disproportional obesity that nearly always affects women and is characterized by bilateral, symmetrical, biker's hosiery-shaped fatty swelling of the legs (2-4). In several cases, arms are also affected by fatty hypertrophy. Edema usually tends to have an orthostatic prolongation. Up to 11% of women or postpubertal girls may be affected to some degree (5), and it is presumably associated with a genetic background (4,5). It is easily distinguishable from other entities like lymphedema and phlebedema based on the striking clinical features, and in numerous cases hormonal dysfunction can also be detected. Lipedema is often combined with common obesity, although lipedematous tissue hardly or never responds to diet and weight-loss. Patients with lipedema nearly always complain of pain upon palpation that worsens with aging. Another hallmark is the frequent hematoma formation due to even minor traumatic injuries (2-4). This might be explained by increased CF although no one has assessed CF in patients with lipedema. Local circulatory abnormalities are seen although major venous dysfunction is rarely found (6).

The peculiar enlargement of subcutaneous fat is presumably linked with microangiopathy and altered microcirculation leading to increased permeability and protein-rich fluid extravasation, which further enhances the amount of lymph. Therefore, in early stages of lipedema, increased lymph flow may be visualized by lymphscintigraphy. Lymph vessels increase their transport capacity because of augmented capillary filtration and increasing volume of interstitial fluid (7). Fluorescent microlymphography displays lymphatic microaneurysms and dilated vessels of the uppermost lymphatic network, indicating that lymph vessels are also involved (8).

In prolonged courses of lipedema, lymph vessels are unable to maintain their function, and altered microcirculation leads to impaired lymph transport capacity and accumulation of lymph fluid. The high protein and fat content of lymph fluid induces a low-grade inflammation and subsequent fibrosis leading to non-pitting edema characterized by Stemmer's sign (5).

CDP for lower extremities consists of manual lymph drainage (MLD), multilayered compression with short-stretch bandages, regular walking exercise, and meticulous skin care (9). Manual lymph drainage (MLD) is a standard and effective therapeutical tool against various forms of primary and secondary lymphedemas. Pressotherapy (IPC) is an adjunctive treatment to MLD which mainly reduces edema and improves venous flow (9). Multilayered compression bandaging plays a crucial role in the further reduction of leg volume enhancing the continuous pumping mechanism using the active involvement of muscle pumps. The most recent, and so far the unique, evidence concerning the conservative approach to lipedema treatment found that intermittent pneumatic compression (IPC) as an adjunctive method was at least equally effective with MLD within complex decongestive physiotherapy (CDP) (10). Based on these data, our clinical practice combines these two distinct elements to treat lipedema patients more efficiently.

It has been observed that beyond volume reduction, the application of CDP in lipedema also reduces the incidence of hematoma formation and reduces touch-induced pain. It may be speculated that hematoma formation can occur on the basis of increased CF (in other terms: decreased CR) that might be modified by CDP. The aim of our study was therefore to measure CF prior and subsequent to CDP in patients with lipedema to assess whether improvement can be documented by less frequent hematoma formation.

PATIENTS AND METHODS

This study enrolled 38 women with bilateral leg lipedema. Patients were recruited at the lymphedema outpatient care unit of the Department of Dermatology and Allergology. All subjects were examined to rule out previous deep vein thrombosis with color Doppler ultrasonography of the legs prior to enrollment. Written informed consent was obtained and the study was approved by the Institutional Review Board of Albert Szent-Györgyi Medical and Pharmaceutical Centre, University of Szeged, Hungary. 42 legs of 21 patients [median age: 54.83 years (range: 31-76 years)] were treated with CDP and 34 legs of 17 [median age: 51.27 years (range: 29-66 years)] women were controls. The control group received no physiotherapy or compression with only a moisturizer (non-ionic hydrophyl ointment) once daily. We additionally enrolled a subject group of ten women [median age: 42.31 years (range: 24-61 years)] without lipedema to measure CF of their 20 legs for comparison of petechiae to that of lipedema patients. CDP consisted of 30 minutes of MLD by Vodder's method (5), performed by a specially trained physiotherapist and an additional IPC [Lympha Press Plus (Mego Afek, Israel) device] for another 30 minutes at 30 mmHg pressure followed by skin care with moisturizers and multilayered short-stretch bandaging with appropriate padding. Subjects took part in walking exercises twice

Fig. 1. Angiosterrometry with vacuum suction method (VSM) using Parrot's device.

daily for 30 minutes. Each subject underwent a 5-day-course with one daily treatment. Leg volumes were measured with the classical Kuhnke's disc method (11), and percent (%) reduction in leg volume was calculated as follows: (initial volume-final volume/initial volume) x 100. CF was evaluated using a vacuum suction chamber before and after the whole course of CDP (12-15). Standardization included continuous room temperature at 22°C and an obligatory 20-min-rest in supine position before angiosterrometry. In each case, skin of the flexor part of both thighs (border of the upper and middle one-third) was tested with the angiosterrometer for the period of 1 minute (*Fig. 1*). The negative pressure in the glass chamber was 30 mmHg. The application of limited negative pressure for a short period on the skin may break and damage some of the most altered and fragile uppermost capillary loops. The number of petechiae was counted within the glass suction cup of the instrument by the same two independent readers (14).

Statistical analysis was performed with ANOVA repeated measures and post-hoc comparisons were completed with Scheffe's test.

RESULTS

Demographics, pre- and post-treatment volume and petechiae results are displayed in *Table 1.* After 5 days of therapy, a 5.66 ± 2.78% (mean ± standard deviation) mean limb volume reduction was achieved in the subjects with lipedema. This volume reduction was significant compared to baseline mean volume ($p<0.05$). The application of decongestive therapy also resulted in a marked reduction in number of petechiae (see example in *Fig. 2*). Mean number of petechiae was 13.95 ± 10.17 at baseline and 8.78 ± 6.88 after CDP ($p=<0.001$). Utilization of moisturizers did not lead to volume reduction nor did it cause a notable decrease in number of petechiae in the control group (12.38 ± 9.35 at baseline and 12.15 ± 8.73 after skin care; $p=0.99$). Mean number of petechiae was 4.10 ± 1.66 for control group without lipedema which was significantly different ($p<0.05$) from that of subjects with lipedema (compared to either CDP or control treatment groups).

DISCUSSION

TABLE 1
Effects of Complex Decongestive Therapy on Limb Volume and Petecchiae (Mean ± SD)

	Study group	Treatment Control group	Population Control group
Number of patients	21	17	10
Number of legs	42	34	20
Mean age (yrs)	52.12 ± 11.37	56.34 ± 11.24	42.31 ± 8.11
Pre-treatment mean volume (cm^3)	16507 ± 2014	15554 ± 1978	9443 ± 1203
Post-treatment mean volume (cm^3)	15623 ± 1884	15453 ± 1823	NA
Pre-treatment mean number of petechiae	13.95 ± 10.17	12.38 ± 9.35	4.10 ± 1.66
Post-treatment mean number of petechiae	8.78 ± 6.88	12.15 ± 8.73	NA

NA=not applicable

Fig. 2. Petechiae prior to CDP.

The most successful conservative therapeutical approach of lipedema is CDP. A critical component of CDP is MLD, a technique of gentle massage which is reported to stimulate lymphangiomotoric activity. It opens up and dilates uninvolved lymph routes and directs lymph away from the edematous arm and, therefore, reduces the volume of the limb by diminishing persistent lymph and softening fibrosis. Intermittent pneumatic devices share similarities with MLD when comparing results. Furthermore,

IPC increases venous flow, tissue oxygenation, accelerates wound healing and reduces relapse rate of leg ulcers. IPC has an adjunctive role to MLD and has been reported (10) to produce a limb volume reduction at nearly the same level of efficacy as MLD. Short-stretch compression bandages play an active role as patients use their muscle pumps. They maintain fluid balance and keep the pumping mechanism active. In the maintenance phase, patients must wear compression grade II or III stockings to preserve achieved volume reduction. The major and most obvious effect of CDP is volume reduction that consequently diminishes the sensation of heavy legs and improves joint mobility. It also reduces accompanying symptoms such as tactile pain and hematoma formation (5). While under CDP treatment, patients tolerate better further treatment elements of CDP and complain of fewer disturbing symptoms. Nevertheless, the level of decongestion which can be achieved by CDP combined with IPC in patients with lipedema is less pronounced compared to that of patients with secondary lymphedema ($p<0.05$) (10,16). The volume of subcutaneous fatty tissue associated lymph fluid in pure lipedema is considerable less compared to static lymph fluid in secondary lymphedema (5).

Hematoma formation is presumably caused by decreased CR (in other terms: increased CF) and possibly by impaired veno-arterial reflex (VAR) (17,18). CF measurement can be accomplished utilizing a very simple, inexpensive, rapid, easily applicable, and repeatable method in upper and lower limbs (15). Belcaro's research group extensively examined macro- and microcirculatory alterations in legs (particularly with chronic venous insufficiency) and found this technique excellent for the measurement of CF and its alteration after therapeutic interventions (15). Our vacuum suction chamber (Parrot's angiosterrometer) can exert an adjustable suction to the examined skin. In our experience, the application of both standard suction negative pressure and suction interval can show CF, and the improvement could be attributed to an improved CF due to CDP. Previously, CR measurements with a vacuum suction chamber verified that atopic dermatitis and involved psoriatic skin did possess an increased CF (14,19).

To our knowledge, this is the first measurement of CF in patients with lipedema. The results clearly demonstrate that in addition to edema reduction, a treatment combination of CDP with IPC has a significant beneficial effect on CF.

ACKNOWLEDGMENTS

The authors thank Professor Dr. Hugo Partsch for his constant help and essential advice in study design and construction of the manuscript. This work was supported by the OTKA (Hungarian Scientific and Research Fund) 5k551 grant.

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