



BTL-6000 LYMPHASTIM

CLINICAL EVIDENCE

SYSTEM FOR PRESSOTHERAPY
CLINICAL AND RESEARCH BACKGROUND



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INTRODUCTION: LYMPHASTIM PRESSOTHERAPY

Lymphatic drainage is well-established and clinically-proven therapeutic method which brings immediate and visible results.

BTL´s Lymphastim works on the pneumatic pressotherapy principle. Special applicator sleeves with multiple overlapping chambers provide gentle massage that encourages the natural circulation of the lymph through the body.

BTL-6000 Lymphastim is used in rehabilitation and sports medicine, lymphology and rheumatology clinics or in spas, wellness hotels and beauty centers. The most common indications are chronic oedemas, venous insufficiency, ischemic diseases and post-surgical obstruction of lymph vessels.

The document gathers publicly known and available studies on the use of pressotherapy.

TITLE: INTERMITTENT PNEUMATIC COMPRESSION ON THE CALF IMPROVES PERIPHERAL CIRCULATION OF THE LEG

Authors: Iwama H., Suzuki M., Hojo M., Kaneda M., Akutsu I.

Affiliations: Trauma and Critical Care Center,

Central Aizu General Hospital, Aizuwakamatsu, Japan

Source: Journal of critical care. 2000; 15(1): 18-21

ABSTRACT:

Purpose:

The aim of this study was to examine whether intermittent pneumatic compression (IPC) increases peripheral circulation locally in order to assess the use of IPC for prevention of deep venous thrombosis.

Materials and methods:

Seventy adult patients receiving major gastrointestinal surgery were studied. On postoperative day 1, calf-length garments were fitted onto both calves and deep temperature thermometers were put on both plantae. The IPC was applied randomly to either the left or right calf under 40 mm Hg pressure for 150 minutes. Bilateral plantar deep temperatures, as a reflection of peripheral circulation in the lower extremity, the tympanic temperature, mean blood pressure, and heart rate were recorded at 15-minute intervals.

Results:

IPC compression was applied to 31 left and 39 right calves. The plantar deep temperature in the compressed calf was higher than in the noncompressed calf, and increased significantly, whereas the noncompressed calf showed no temperature change. The tympanic temperature, mean blood pressure, and heart rate did not change during the experiment.

Conclusion:

The results suggest that IPC has the effect of improving peripheral circulation, which supports the use of IPC to prevent deep venous thrombosis.



TITLE: INTERMITTENT PNEUMATIC COMPRESSION TO PREVENT PROXIMAL DEEP VENOUS THROMBOSIS DURING AND AFTER TOTAL HIP REPLACEMENT

Authors: Farzana K., S., Azm M., R., Tariqul I., Ahsan H., Khurshid M., Shahidul H.

Affiliations: Department of Physical Medicine and Rehabilitation, Chittagong Medical College, Chittagong, Bangladesh

Source: Bangladesh Journal of Neuroscience. 2011; 27(2):64-68

ABSTRACT:

A prospective, randomized study of the effectiveness of intraoperative and postoperative use of intermittent pneumatic compression, alone or in combination with oral administration of either aspirin or low-dose warfarin, was done of a consecutive series of patients who had a total hip replacement and were more than thirty-nine years old. All patients began walking by the third postoperative day. One hundred and ninety patients who had 217 total hip arthroplasties were included. Twenty-eight per cent of the procedures were revisions of a previous total hip replacement or of an endoprosthesis, and the remainder were primary arthroplasties. Patients were randomized as to the type of prophylaxis that they received: intermittent pneumatic compression alone, seventy-six hips; intermittent pneumatic compression and aspirin, seventy-two hips; or intermittent pneumatic compression and low-dose warfarin, sixty-nine hips. Before discharge from the hospital, and at an average of seven days after the operation, all patients were evaluated for the presence of proximal deep-vein thrombosis with either venography on the side of the operation or with bilateral venous ultrasonography. The relative frequency with which thrombosis occurred in a proximal vein was not significantly different in the three groups; the over-all relative frequency was 10 per cent.

Intermittent compression during and after the operation effectively reduces the rate of proximal-vein thrombosis after total hip replacement. With the number of patients in our study, the effectiveness of this technique could not be shown to be augmented by oral administration of either aspirin or low-dose warfarin.



TITLE: EFFECTS OF INTERMITTENT PNEUMATIC LEG COMPRESSION FOR PREVENTION OF POSTOPERATIVE DEEP VENOUS THROMBOSIS WITH SPECIAL REFERENCE TO FIBRINOLYTIC ACTIVITY

Authors: Inada K. et al.

Affiliations: First Department of Surgery, Gifu University School of Medicine, Japan

Source: American Journal of Surgery. 1988; 155(4): 602-605

ABSTRACT:

The mechanism of intermittent pneumatic leg compression for prevention of postoperative deep venous thrombosis was investigated. The incidence of postoperative deep venous thrombosis was studied using iodine-125 fibrinogen in 64 patients with malignant disease who had intermittent pneumatic leg compression for 48 hours postoperatively. Changes in euglobulin lysis time and B beta 15-42 peptide were investigated before and after operation in 16 patients with benign disease, in 27 patients with malignant disease who did not have postoperative intermittent pneumatic leg compression, and in another 29 patients with malignant disease who had postoperative intermittent pneumatic leg compression. The overall incidence of deep venous thrombosis was 6.25 percent. A prolongation of euglobulin lysis time was found postoperatively in all three groups, which was significant in malignant disease groups, although less significant in the group with intermittent pneumatic leg compression when compared with the benign disease group. Preoperatively, a significant increase in B beta 15-42 peptide was found in patients with malignant disease when compared with patients with benign disease. Postoperatively, the B beta 15-42 level increased in the same pattern in all groups and no significant differences in the levels were found among them. A significant shortening of euglobulin lysis time by intermittent pneumatic leg compression, in addition to its hemodynamic effects, is considered an important factor in the prevention of postoperative deep venous thrombosis.



TITLE: PREVENTION OF POSTOPERATIVE VENOUS THROMBOEMBOLISM BY EXTERNAL PNEUMATIC CALF COMPRESSION IN PATIENTS WITH GYNAECOLOGIC MALIGNANCY

Authors: Clarke-Pearson D., L. et al.

Affiliations: The Division of Gynecologic Oncology, Department of Obstetrics and Gynecology, the Comprehensive Cancer Center Database, and the Department of Radiology, Duke University Medical Center, Durham, North Carolina

Source: Obstetrics and gynecology. 1984; 63(1): 92-108

ABSTRACT:

One hundred seven patients undergoing major surgery for gynecologic malignancy participated in a controlled trial evaluating the effectiveness of pneumatic calf compression in the prevention of postoperative deep venous thrombosis and pulmonary embolism. External pneumatic calf compression was applied intraoperatively and for five postoperative days. All patients were prospectively screened for deep venous thrombosis with impedance plethysmography and ¹²⁵I-fibrinogen leg counting. Deep venous thrombosis and/or pulmonary emboli were detected in 18 of 52 control group patients (34.6%) whereas in seven of 55 (12.7%) of those treated with external pneumatic calf compression (P less than .005). External pneumatic calf compression was most effective during the first five days postoperatively and also reduced the incidence of deep venous thrombosis in patients at highest risk. When applied during surgery and for five days postoperatively, external pneumatic calf compression significantly reduces the incidence of postoperative venous thrombosis.



TITLE: INHIBITION OF TISSUE FACTOR PATHWAY DURING INTERMITTENT PNEUMATIC COMPRESSION: A POSSIBLE MECHANISM FOR ANTITHROMBOTIC EFFECT

Authors: Chouhan V, D., Comerota A., J., Sun L., Harada R., Gaughan J., P., Rao A., K.

Affiliations: Department of Medicine, The Sol Sherry Thrombosis Research Center, Temple University School of Medicine, Philadelphia, PA 19140, USA

Source: Arteriosclerosis, thrombosis, and vascular biology. 1999; 19(11): 2812-2817

ABSTRACT:

Intermittent pneumatic compression (IPC) devices are an effective prophylaxis against lower extremity deep vein thrombosis. Their antithrombotic effect has been attributed to a reduction in venous stasis and enhanced fibrinolysis. The initiating mechanism for blood coagulation is the tissue factor (TF) dependent pathway, which is inhibited by tissue factor pathway inhibitor (TFPI). We have investigated the effect of IPC on the TF pathway in 6 normal subjects and 6 patients with post thrombotic venous disease undergoing IPC for 120 minutes; all subjects were studied with each of 5 IPC devices. In normal subjects and patients, plasma factor VIIa (FVIIa) activity (the activated form of factor VII [FVII]) declined from mean values ranging 51 to 65 and 50 to 53 mU/mL before IPC with different devices to 10 to 13 and 20 to 22 mU/mL at 180 minutes, respectively ($P < 0.001$ for all groups). FVII antigen levels were unchanged. Plasma TFPI ($P < 0.001$) rose from mean baseline values ranging 69 to 79 and 57 to 61 ng/mL to 76 to 123 and 71 to 79 ng/mL at 180 minutes in normal subjects and patients, respectively ($P < 0.001$ for all groups). Plasma prothrombin fragment F1.2 levels showed minimal changes. There was an inverse relationship between TFPI and FVIIa in normal subjects ($r = -0.31$, $P = 0.001$) and patients ($r = -0.37$, $P < 0.001$). IPC results in an increase in plasma TFPI and decline in FVIIa. Inhibition of TF pathway, the initiating mechanism of blood coagulation, is a possible mechanism for the antithrombotic effect of IPC.



TITLE: EFFICIACY OF PROPHYLAXIS AGAINST THROMBOEMBOLISM WITH INTERMITTENT PNEUMATIC COMPRESSION AFTER PRIMARY AND REVISION TOTAL HIP ARTHROPLASTY

Authors: Hooker J., A., Lachiewicz P., F., Kelley S., S.

Affiliations: Department of Orthopaedics, University of North Carolina, Chapel Hill, USA

Source: The journal of bone and joint surgery. 1999; 81(5): 690-696

ABSTRACT:

Background:

Thromboembolism is a common and important complication after total hip arthroplasty. A variety of pharmacological and mechanical measures have been proposed for prophylaxis. The purpose of the present study was to evaluate the efficacy of intermittent pneumatic compression as prophylaxis against thromboembolism following total hip arthroplasty.

Methods:

The prospective study involved a consecutive series of 425 patients in whom a total of 502 (324 primary and 178 revision) total hip arthroplasties had been performed by two surgeons. The patients were managed intraoperatively and postoperatively with use of thigh-high elastic compression stockings and thigh-high intermittent pneumatic compression sleeves. Experienced vascular technologists performed venous duplex ultrasonography on both lower extremities of all patients at a mean of six days (range, two to fifteen days) postoperatively. All patients were followed for at least one year in order to detect late thromboembolism.

Results:

An asymptomatic deep-vein thrombosis was noted on the scans made after twenty-three (4.6 percent) of the 502 procedures. Nineteen (3.8 percent) of the arthroplasties were followed by the development of a proximal thrombosis and four (0.8 percent), a distal thrombosis. Nineteen of the thromboses were ipsilateral (eighteen were proximal and one, distal), and four were contralateral (one was proximal and three, distal). No symptomatic deep-vein thrombosis developed in the hospital. In addition, three (two proximal and one distal) symptomatic ipsilateral deep-vein thromboses (a prevalence of 0.6 percent) developed three to twenty-three weeks after postoperative scans revealed negative findings and the patients were discharged from the hospital. Three symptomatic pulmonary embolisms (a prevalence of 0.6 percent) were confirmed by ventilation-perfusion scanning while the patients were in the hospital. There were no symptomatic pulmonary embolisms after discharge, and there were no fatal pulmonary embolisms. With the numbers available, we were unable to detect an association between deep-vein thrombosis and age ($p = 0.76$), gender ($p = 0.13$), body-mass index ($p = 0.12$), type of arthroplasty (primary or revision) ($p = 0.12$), operative approach ($p = 0.37$), duration of the operation ($p = 0.21$), type of anesthesia (general or regional) ($p = 0.51$), units of blood transfused (autologous, $p = 0.79$; homologous, $p = 0.57$), blood type ($p = 0.18$), or the presence of a so-called classic risk factor for the development of thrombosis ($p = 0.22$). Five arthroplasties (1.0 percent) were followed by the development of a wound hematoma, but only one hematoma necessitated operative drainage.

Conclusions:

The use of intraoperative and postoperative thigh-high intermittent pneumatic compression, combined with duplex ultrasonography performed by experienced vascular technologists, is effective for prophylaxis against thromboembolism after both primary and revision total hip arthroplasties. The low prevalence of deep-vein thrombosis (4.6 percent) and symptomatic pulmonary embolism (0.6 percent) is comparable with that associated with pharmacological prophylaxis.



TITLE: THROMBOEMBOLISM AFTER TOTAL KNEE ARTHROPLASTY: INTERMITTENT PNEUMATIC COMPRESSION AND ASPIRIN PROPHYLAXIS

Authors: Larson M., MacMillan P., Lachiewicz P., F.

Affiliations: Department of Orthopaedics, University of North Carolina, Chapel Hill, USA

Source: Journal of the Southern Orthopaedic Association. 2001; 10(3): 155-163

ABSTRACT:

This is a study of two consecutive antithromboembolism regimens after total knee arthroplasty. In group 1, 131 patients were given aspirin prophylaxis alone (650 mg by mouth twice a day). In group 2, 123 patients were treated with aspirin, knee-high compression stockings, and intermittent knee-high pneumatic compression devices, which were started intraoperatively. The prevalence of deep vein thrombosis in group 1 was 15.9% (21 of 131 patients). One patient had a possible symptomatic nonfatal pulmonary embolism, and one patient had a symptomatic calf thrombus. Asymptomatic thrombi were detected in calf veins in 9 patients, popliteal vein in 6 patients, and femoral vein in 5 patients. In Group 2, the prevalence was 7.4% (9 of 123 patients). Asymptomatic thrombi were located in calf veins in 6 patients, popliteal vein in 1 patient, and femoral vein in 2 patients. There was a significant difference in the prevalence of deep vein thrombosis between the two groups. A history of previous thromboembolism was a significant risk factor for a new thrombus. The prevalence after bilateral one-stage knee arthroplasty was 24.3% for group 1 and 12.5% for group 2. Aspirin and knee-high intermittent pneumatic compression together are more effective than aspirin alone for prevention of deep vein thrombosis after primary and revision knee arthroplasty.



TITLE: AN IN VITRO CELL CULTURE SYSTEM TO STUDY THE INFLUENCE OF EXTERNAL PNEUMATIC COMPRESSION ON ENDOTHELIAL FUNCTION

Authors: Dai G., Tsukurov O., Orkin R., W., Abbot W., M., Kamm R., D., Gertler J., P.

Affiliations: Division of Bioengineering and Environment Health, Massachusetts Institute of Technology and the Vascular Surgery Laboratory, Division of Vascular Surgery, Massachusetts General Hospital, Boston, MA 02114, USA

Source: Journal of vascular surgery. 2000; 32(5): 977-987

ABSTRACT:

Purpose:

External pneumatic compression (EPC) is an effective means of prophylaxis against deep venous thrombosis. However, its mechanism remains poorly understood. Understanding of the biological consequences of EPC is an important goal for optimizing performance of the EPC-generating device and providing guidance for clinical use. We present a new in vitro cell culture system (Venous Flow Simulator) that simulates blood flow and vessel collapse conditions during EPC, and we examine the influence of these factors on endothelial cell (EC) fibrinolytic activity and vasomotor function.

Methods:

An in vitro cell culture system was designed to replicate the hemodynamic shear stress and vessel wall strain associated with induced blood flow during different modes of EPC. Human umbilical vein endothelial cells were cultured in the system and subjected to intermittent flow, vessel collapse, or a combination of the two. The biologic response was assessed through changes in EC morphology and the expression of fibrinolytic factors tissue plasminogen activator, plasminogen activator inhibitor type 1, profibrinolytic receptor (annexin II), and vasomotor factors endothelial nitric oxide synthase and endothelin-1.

Results:

The cells remained attached and viable after being subjected to intermittent pulsatile flow (F) and tube compression (C). In F and F + C, cells aligned in the direction of flow after 6 hours. Northern blot analysis of messenger RNA shows that there is an upregulation of tissue plasminogen activator expression (1.95 +/- 0.19 in F and 2.45 +/- 0.46 in FC) and endothelial nitric oxide synthase expression (2.08 +/- 0.25 in F and 2.11 +/- 0.21 in FC). Plasminogen activator inhibitor type 1, annexin II, and endothelin 1 show no significant change under any experimental conditions. The results also show that pulsatile flow, more than vessel compression, influences EC morphology and function.

Conclusion:

Effects on ECs of intermittent flow and vessel collapse, either individually or simultaneously, were simulated with an in vitro system of new design. Initial results show that intermittent flow associated with EPC upregulates EC fibrinolytic potential and influences factors altering vasomotor tone. The system will facilitate future studies of EC function during EPC.



TITLE: EFFECTS OF INTERMITTENT PNEUMATIC COMPRESSION OF THE FOOT ON THE MICROCIRCULATORY FUNCTION IN ARTERIAL DISEASE

Authors: Abu-Own A, Cheatle T., Scurr J., H., Coleridge S.

Affiliations: Department of Surgery, University College and Middlesex School of Medicine, London, U.K.

Source: European journal of vascular surgery. 1993; 7(5): 488-492

ABSTRACT:

Objective:

The venous pump of the foot assists blood returning to the heart. The aim of this study was to evaluate the effect of mechanical activation of the foot pump on the microcirculation of the skin in patients with peripheral occlusive arterial disease.

Design:

Single parallel group comparing patients with arterial disease to normal control subjects.

Setting:

Department of Surgery, the University College and Middlesex Hospital, London, U.K.

Subjects and materials:

15 patients with peripheral occlusive arterial disease and 15 control subjects. A pneumatic impulse foot pump was applied to the foot.

Outcome measures:

The Laser Doppler flux (LDF) and transcutaneous oxygen tension (tcPO₂) were measured on the big toe with the subject supine, before, during and after a 10 min period of foot pumping. The study was repeated with the subject sitting.

Results:

On sitting there is a fall in LDF and rise in tcPO₂. Application of intermittent pneumatic compression of the foot in the sitting position resulted in an increase in LDF. In patients, the median percentage increase was 57% and the median difference was 82 arbitrary units (AU) (95% CI 60-130, $p < 0.001$). In controls, the median percentage increase was 66% and the median difference was 124 AU (95% CI 73-275 $p < 0.001$). There was a corresponding "further" increase in tcPO₂ in both groups of subjects. In patients, the median percentage increase was 8%, in controls the median percentage increase was 10% ($p < 0.01$).

Conclusion:

We conclude that intermittent pneumatic compression of the foot in the dependent position increases LDF and tcPO₂.



TITLE: ROLE OF NITRIC OXIDE IN VASODILATION IN UPSTREAM MUSCLE DURING INTERMITTENT PNEUMATIC COMPRESSION

Authors: Chen et al.

Affiliations: The Orthopaedic Microsurgery Laboratory, Department of Surgery, Duke University Medical Center, Durham, North Carolina 27710, USA

Source: Journal of applied physiology. 2002; 92(2): 559-566

ABSTRACT:

This study investigated the dosage effects of nitric oxide synthase (NOS) inhibitor N(G)-monomethyl-L-arginine (L-NMMA) on intermittent pneumatic compression (IPC)-induced vasodilation in uncompressed upstream muscle and the effects of IPC on endothelial NOS (eNOS) expression in upstream muscle. After L-NMMA infusion, mean arterial pressure increased by 5% from baseline (99.5 +/- 18.7 mmHg; P < 0.05). Heart rate and respiratory rate were not significantly affected. One-hour IPC application on legs induced a 10% dilation from baseline in 10- to 20-microm arterioles and a 10-20% dilation in 21- to 40-microm arterioles and 41- to 70-microm arteries in uncompressed cremaster muscle. IPC-induced vasodilation was dose dependently reduced, abolished, or even reversed by concurrently infused L-NMMA. Moreover, expression of eNOS mRNA in uncompressed cremaster muscle was upregulated to 2 and 2.5 times normal at the end of 1- and 5-h IPC on legs, respectively, and the expression of eNOS protein was upregulated to 1.8 times normal. These increases returned to baseline level after cessation of IPC. The results suggest that eNOS plays an important role in regulating the microcirculation in upstream muscle during IPC.



TITLE: EFFECTS OF INTERMITTENT PNEUMATIC COMPRESSION OF THE CALF AND THIGH ON ARTERIAL CALF INFLOW: A STUDY OF NORMALS, CLAUDICANTS, AND GRAFTED ARTERIOPATHS

Authors: Abu-Own A, Cheatle T., Scurr J., H., Coleridge S.

Affiliations: Department of Surgery, University College and Middlesex School of Medicine, London, U.K.

Source: *European journal of vascular surgery*. 1993; 7(5): 488-492

ABSTRACT:

Background:

Recent data indicate that intermittent pneumatic compression (IPC) of the foot may offer benefits in patients with intermittent claudication exceeding those of standard medications approved by the Food and Drug Administration. IPC of the foot (IPC(foot)) and calf (IPC(calf)) increases flow velocity in infrainguinal arterial bypass grafts and thus may prevent arterial thrombosis. Our aim was to evaluate the acute effects of IPC of the thigh (IPC(thigh)), IPC(calf), and IPC of the thigh and calf (IPC(calf + thigh)) in healthy controls, claudicants, and arteriopathes who have undergone infrainguinal bypass grafting for critical or subcritical limb ischemia.

Methods:

Sixteen limbs of normals (group A), 17 limbs of claudicants (group B), and 16 limbs of arteriopathes (group C) who had undergone infrainguinal autologous revascularization were studied. Blood flow was measured in the limbs of normals and claudicants in the popliteal artery and in the grafts of revascularized limbs by using duplex ultrasonography. Mean velocity (mV), peak systolic velocity, end diastolic velocity (EDV), pulsatility index (PI), and volume flow (Q) were measured in the sitting position at rest and within 10 seconds from the delivery of IPC(thigh), IPC(calf), and IPC(calf + thigh), IPC was delivered at maximum inflation and deflation pressures of 120 mm Hg and 0 mm Hg, respectively; inflation and deflation times of 4 and 16 seconds, respectively; and a proximal inflate delay of 1 second (calf compression preceding that of thigh).

Results:

In all 3 groups with all IPC modes, the Q, mV, and EDV increased while PI decreased ($P < .05$). IPC(thigh) was less effective than IPC(calf), but still increased Q (by 114%, 57%, and 59.8% in groups A, B, and C, respectively) and EDV, while decreasing PI in all 3 groups ($P < .05$). IPC(calf + thigh) was the most efficient mode, generating an increase in the median Q of 424% in controls, 229% in claudicants, and 317% in grafted arteriopathes. The addition of IPC(thigh) to IPC(calf) increased the mV and Q in group A ($P < \text{or} = .044$); the mV, Q, and EDV in group B ($P < \text{or} = .03$), and mV and PI by 24% and -27% in group C, respectively.

Conclusions:

IPC applied to the thigh, either alone or in combination with IPC(calf), generates native arterial and infrainguinal autologous graft flow enhancement. The paucity of conservative methods available for lower limb blood flow augmentation may allow IPC of the lower limb to emerge as a reliable, noninvasive therapeutic option, ameliorating claudication and assisting infrainguinal bypass graft flow. IPC(thigh) adds to the armamentarium of currently known IPC options (foot or calf) promoting its applicability and efficacy.



TITLE: EFFECT OF EXTERNAL SEQUENTIAL COMPRESSION DEVICES ON FEMORAL VENOUS BLOOD FLOW

Authors: Markel D., C., Morris G., D.

*Affiliations: Department of Orthopaedic Surgery, Providence Hospital,
Southfield, Mich 48075, USA*

Source: Journal of the Southern Orthopaedic Association. 2002; 11(1): 2-9

ABSTRACT:

Sequential compression devices are used to reduce venous stasis and deep venous thrombosis after joint replacement. Thigh-length, calf-length, and foot compression devices were compared in using ultrasonography after unilateral knee arthroplasty. Simulated muscle activity via active ankle motion was also evaluated. Blood flow volume and velocity were recorded above and below the saphenous vein bifurcation, the division of the superficial and deep systems, allowing evaluation of each. Volume and velocity increased in the superficial and deep systems with all devices. A control group was evaluated to determine differences related to age and surgery. The devices performed similarly in the volunteers. However, active motion performed better than any device. Thus, unlike young, healthy patients, muscle activity alone in the operative population was unreliable in increasing blood flow. Thigh-length, calf-length, and foot compression devices are effective at increasing femoral blood flow volume and velocity in the deep and superficial venous systems after total knee arthroplasty.



TITLE: ENHANCING FOOT SKIN BLOOD FLUX IN PERIPHERAL VASCULAR DISEASE USING INTERMITTENT PNEUMATIC COMPRESSION: CONTROLLED STUDY ON CLAUDICANTS AND GRAFTED ARTERIOPATHS

Authors: Delis K., T., Husmann M., J., Nicolaidis A., N., Wolfe J., H., Cheshire N., J.

Affiliations: Irvine Laboratory, Academic Vascular Surgery, Imperial College School of Medicine, St. Mary's Hospital, QEQM Wing 10th Floor, Praed Street, Paddington, London W2 1NY, UK

Source: World journal of surgery. 2002; 26(7): 861-866

ABSTRACT:

Intermittent pneumatic leg compression (IPC) increases arterial calf inflow and foot skin blood flux in normal subjects and claudicants. Our hypothesis was that IPC could enhance foot skin blood flux after infrainguinal grafting and thus promote distal perfusion in limbs with tissue loss. The aim of this study was to compare the effects of three IPC modes [applied to the foot (IPC foot), the calf (IPC calf), or both (IPC foot+calf)] on foot skin perfusion in healthy individuals, claudicants, and patients after infrainguinal arterial revascularization performed for critical or subcritical limb ischemia. Altogether, 20 healthy limbs, 22 claudicating limbs, and 36 limbs of arteriopathies with prior successful autologous femoropopliteal and femorodistal (18 each) grafts were examined. Five-minute laser Doppler recordings were obtained from the pulp of the big toe in the sitting position, at rest, and during random applications of IPC foot, IPC calf, and IPC foot+calf delivered at 120 mmHg for 4 seconds three times per minute. Foot skin blood flux increased using all IPC modes ($p < 0.001$), with IPC foot and IPC foot+calf generating higher flux levels than IPC calf ($p < 0.01$) in all groups. Intergroup differences of flux with each of the three IPC modes were not significant. IPC foot and IPC foot+calf similarly ($p > 0.14$) produced a higher percentage flux increase than IPC calf in all groups ($p < 0.004$). Controls had a higher percentage flux increase with both IPC calf and IPC foot than did claudicants ($p = 0.016$). No differences were documented between normal and grafted limbs ($p > 0.05$). The percentage flux increase with IPC foot+calf and IPC calf was significantly higher in femorodistal grafts than in femoropopliteal ones ($p = 0.026$). IPC enhances skin blood flux in limbs with infrainguinal bypass, claudication, and normal arteries, with IPC foot and IPC foot+calf being more effective than IPC calf. Our findings suggest that IPC may be beneficial in limbs with impaired distal perfusion and thus may have clinical implications in the treatment of leg ulcers either prior to or after revascularization.



TITLE: INTERMITTENT SEQUENTIAL COMPRESSION OF THE LOWER LIMBS PREVENTS VENOUS STASIS IN LAPAROSCOPIC AND CONVENTIONAL COLORECTAL SURGERY

Authors: Schwenk et al.

Affiliations: Department of General Surgery, Charité, Medical Faculty of the Humboldt-University, Berlin, Germany

Source: *Disease of the colon and rectum*. 1997; 40(9): 1056-1062

ABSTRACT:

Purpose:

This study was designed to evaluate the influence of intraoperative intermittent sequential compression (ISC) on venous blood return from the lower limbs during laparoscopic and conventional colorectal colectomy.

Methods:

Fifty patients undergoing laparoscopic (n = 25) or conventional (n = 25) colorectal surgery were included in a prospective study. Peak venous flow (PFV) and the cross-sectional area (CSA) of the femoral vein were assessed by Doppler ultrasound examination intraoperatively.

Results:

Age, gender, and body mass index were comparable between both groups. Baseline PFV was 21 +/- 6.6 cm/s in the conventional and 18.4 +/- 6.4 cm/s in the laparoscopic group (P = 0.2). ISC increased PFV to 156 +/- 29 percent of the baseline value in the conventional group and to 161 +/- 29 percent in the laparoscopic group. PFV decreased after abdominal insufflation to 127 +/- 19 percent of the baseline value in the laparoscopic group and after laparotomy to 134 +/- 27 percent in the conventional group (P = 0.3). PFV decreased slightly in both groups during surgery but remained well above the baseline value. Baseline CSA was 1.02 +/- 0.17 cm² in the conventional group and 1 +/- 0.23 cm² in the laparoscopic group. ISC decreased CSA to 0.91 +/- 0.18 cm² (conventional) and 0.85 +/- 0.18 cm² (laparoscopic) after initiation of ISC. CSA was 0.92 +/- 0.18 cm² after abdominal insufflation in the laparoscopic group, and it was 0.93 +/- 0.18 cm² after laparotomy in the conventional group (P = 0.4). During surgery, there were no differences in absolute CSA or CSA changes compared with the baseline value in both groups. Postoperative circumference of the calf and thigh were not different between both groups. Postoperative thromboembolic complications did not occur.

Conclusion:

ISC effectively increases venous blood flow from the lower limbs during conventional and laparoscopic colorectal resections and may decrease the risk of postoperative deep vein thrombosis. Therefore, ISC is strongly recommended in every prolonged laparoscopic procedure.



TITLE: INTERMITTENT SEQUENTIAL PNEUMATIC COMPRESSION IN PREVENTION OF VENOUS STASIS ASSOCIATED WITH PNEUMOPERITONEUM DURING LAPAROSCOPIC CHOLECYSTECTOMY

Authors: Millard J., A. et al.

Affiliations: Department of Surgery, Saint Joseph Hospital, Denver, Colo

Source: Archives of Surgery. 1993; 128(8): 914-919

ABSTRACT:

Objectives:

To determine whether pneumoperitoneum and reverse Trendelenburg's position used during laparoscopy impede common femoral venous flow and whether calf-length intermittent sequential pneumatic compression (ISPC) overcomes this impedance.

Design:

Using Doppler ultrasonography, peak systolic velocities in the common femoral vein were measured in patients undergoing laparoscopic cholecystectomy with peritoneal insufflation of carbon dioxide. Measurements were obtained during three intervals: preoperatively with the patients in the supine position; after induction of general anesthesia with the patients in the supine position; and after insufflation to 13 to 15 mm Hg with the patients in the 30 degrees reverse Trendelenburg position (both with and without ISPC). Mean arterial pressure and heart rate were obtained concurrently. Measurements of preoperative and postoperative calf and thigh circumferences were obtained.

Setting:

A tertiary care center. PATIENT PARTICIPANTS: A consecutive sample of 20 patients 30 to 70 years of age (15 women and five men) who underwent laparoscopic cholecystectomy and met the inclusion criteria.

Main outcome measures:

Peak systolic velocity, mean arterial pressure, heart rate, and calf and thigh circumferences.

Results:

The combination of pneumoperitoneum to 13 to 15 mm Hg and a 30 degrees reverse Trendelenburg position significantly decreased peak systolic velocity in the common femoral vein from a preoperative mean of 0.24 +/- 0.025 m/s to 0.14 +/- 0.011 m/s, or a 42% decrease. Intermittent sequential pneumatic compression reversed that effect, returning peak systolic velocity to 0.27 +/- 0.021 m/s. The mean difference between preoperative peak systolic velocity and peak systolic velocity with a combination of pneumoperitoneum, reverse Trendelenburg's position, and ISPC was 0.03 +/- 0.03 m/s but was not significant. Anesthesia alone caused a mean increase in preoperative peak systolic velocity from 0.24 +/- 0.025 m/s to 0.3 +/- 0.032 m/s. Mean arterial pressure levels, heart rate, and calf and thigh circumferences did not change significantly.

Conclusions:

This study demonstrated a significant reduction in common femoral venous flow during laparoscopic cholecystectomy coincident with pneumoperitoneum and reverse Trendelenburg's position. Intermittent sequential pneumatic compression reversed that effect, returning peak systolic velocity to normal.



TITLE: LASER DOPPLER VASOMOTION AMONG PATIENTS WITH POST-THROMBOTIC VENOUS INSUFFICIENCY: EFFECT OF INTERMITTENT PNEUMATIC COMPRESSION

Authors: Pekanmäki K., Kolari P., J., Kiistala U.

Affiliations: Department of Dermatology, Päijät-Häme Central Hospital, Lahti, Finland

Source: VASA. Zeitschrift für Gefässkrankheiten. 1991; 20(4): 394-397

ABSTRACT:

Laser Doppler fluxmetry (LDF) was used to measure skin blood flux and its vasomotion, i.e. rhythmical variations in nineteen patients with post-thrombotic venous insufficiency, and in eight healthy control subjects before and after a single intermittent pneumatic compression treatment session. Following the compression treatment session skin blood flux increased and vasomotion was seen in all the patients. The transcutaneous oxygen tension also increased slightly, but significantly, from 25.4 (range 3-56) mmHg to 30.8 (range 7-61) mmHg (p less than 0.01). It is suggested that IPC treatment decreases venous distention and venous pressure thereby decreasing vasoconstrictor stimulus. This seems to restore normal skin blood flow including vasomotion.



TITLE: EVALUATION OF SEQUENTIAL INTERMITTENT PNEUMATIC COMPRESSION FOR FILARIAL LYMPHOEDEMA

Authors: Manjula Y, Kate V, Ananthkrishnan N.

Affiliations: Jawaharlal Institute of Postgraduate Medical Education and Research,
Pondicherry, India

Source: *The National Medical Journal of India*. 2002; 15(4): 192-194

ABSTRACT:

Background:

Lymphoedema is a major cause of morbidity in patients with lymphatic filariasis. There is no effective medical treatment and the results of surgery are uncertain. There are very few published studies assessing the volumetric response to the use of sequential intermittent pneumatic compression (SIPC) in patients.

Methods:

A 12-celled instrument capable of providing sequential compression from the distal to proximal direction was used in 28 patients with unilateral grades II (n=17) and III (n=11) filarial lymphoedema in a planned 4-week session. The patients were followed up for 6 months after compression therapy by water displacement volumetry.

Results:

We found that 12 patients with grade II filarial lymphoedema had >26% reduction in oedema volume immediately after compression, but this reduction (>26%) was maintained in only 7 at 6 months. The corresponding figures for grade III filarial lymphoedema were 6 and 4, respectively. The effect in grade III was less sustained than grade II. No complications attributable to SIPC were seen. An added advantage of SIPC was a significant decrease in attacks of adenolymphangitis after compression when compared to pre-compression frequency. These observations were seen even with non-compliance to both foot care measures and use of bandages to maintain reduction in oedema volume.

Conclusion:

SIPC reduces morbidity in filarial lymphoedema though the effect is not sustained. It is simple, easy to use and could form part of the morbidity control programme for lymphatic filariasis.



TITLE: IMPROVEMENT IN HEALING WITH AGGRESSIVE EDEMA REDUCTION AFTER DEBRIDEMENT OF FOOT INFECTION IN PERSONS WITH DIABETES

Authors: Armstrong D, G., Hinevu C., N.

Affiliations: Department of Orthopaedics, University of Texas Health Science Center, San Antonio (nd the Department of Surgery, Southern Arizona Veterans Affairs Medical Center, Tucson, USA

Source: Archive of Surgery. 2000; 135: 566-74

ABSTRACT:

Background:

Infected foot wounds in patients with diabetes are the most common reason for diabetes-related hospital admission in the United States. Nonhealing foot wounds are the major precipitant of lower-extremity amputation in the diabetic population.

Hypothesis:

The null hypothesis was that there would be no difference in proportion of healing with or without use of a foot-level mechanical compression device.

Methods:

Twelve week, double-blind, randomized, controlled trial. A university teaching hospital and related clinics. One hundred fifteen patients with diabetes, 74% male, with foot infections requiring incision and debridement. All patients received either a functioning or placebo (nonfunctioning) foot compression device (Kinetic Concepts Inc, San Antonio, Tex). Patients and investigators were blinded to the functionality of the device.

Results:

There was a significantly higher proportion of healing in the active group than in the placebo group (39 [75%] of 52 patients vs 23 [51%] of 45; $\chi^2=6.0$; $P<.02$; odds ratio, 2.9; 95% confidence interval, 1.2-6.8). In the placebo group, there was no difference in proportion of healing between those identified as compliant (>50 hours of use per week) vs noncompliant ($P = .10$). In patients receiving active units, more patients in the compliant subgroup experienced wound healing ($P<.03$). When compared as whole, there was a significant trend toward an increasing proportion of healing from the placebo-noncompliant to the placebo-compliant to the active-noncompliant to the active-compliant groups ($\chi^2_{trend}=8.3$; $P<.005$).

Conclusions:

Edema reduction achieved in this study by way of a pump and wrap system may increase the proportion of wound healing in patients after debridement of foot infections in patients with diabetes. Furthermore, the data suggest a potential association between increased compliance with use of the device and an increased trend toward wound healing.



TITLE: CHANGES IN POSTTRAUMATIC ANKLE JOINT MOBILITY, PAIN, AND EDEMA FOLLOWING INTERMITTENT PNEUMATIC COMPRESSION THERAPY

Authors: Airaksinen O.

Affiliations: Department of PM&R, Kuopio University Central Hospital, Finland

Source: Archives of physical medicine and rehabilitation. 1989; 70(4): 341-344

ABSTRACT:

The changes in posttraumatic ankle joint mobility, pain, and edema following intermittent pneumatic compression (IPC) therapy were examined in patients with lower leg fractures after six to 12 weeks of immobilization in a cast. The study group consisted of 22 patients with distal fractures of the lower leg. Each patient was given IPC treatment on five consecutive days for 75 minutes daily. The control group consisted of 12 patients with lower leg fractures who were not given any treatment. Ankle joint mobility in the study group increased by 11.9 degrees (SE = 1.5), but by only 1.0 degree (SE = 0.8) in the control group. The difference is highly significant (p less than 0.001). The study group also experienced markedly greater pain relief than did the control patients. The reduction of edema was 170 ml (SE = 23) in the study group and only 15 ml (SE = 12) in the control group (p less than 0.001). This study suggests that IPC treatment promotes the rehabilitation of the posttraumatic conditions.



TITLE: LONG-TERM RESULTS OF COMPRESSION TREATMENT FOR LYMPHEDEMA

Authors: Pappas C., J., O'Donnell T., F.

Affiliations: Department of Surgery, New England Medical Center Hospitals, Tufts University School of Medicine, Boston, MA

Source: Journal of vascular surgery. 1992; 16(4): 562-564

ABSTRACT:

Although numerous operations have been devised for lymphedema, most surgeons manage this vexing condition by nonsurgical means. Previous studies by us showed that high-pressure (90 to 100 torr) sequential external pneumatic compression (SEP) reduced both limb girth and volume in a lymphedematous extremity. To assess the long-term effects of a program entailing (1) SEP, (2) elastic compression stockings to maintain the post-SEP girth, and (3) daily skin care, we reviewed the long-term courses of 49 patients managed by one surgeon. Limb girths measured at nine levels on the limb were obtained serially in follow-up (mean 25 months) by an independent observer to provide an objective response to therapy. The relative reduction in lymphedematous tissue was determined by the difference between the pretreatment, postacute treatment, and long-term treatment girths at nine points in the limb. In long-term follow-up, 26 of the patients maintained a full response (reduction at > 3 levels), whereas 10 maintained a partial response (reduction at ≤ 3 levels). At late follow-up, calf and ankle girths were reduced by an absolute value of 5.37 ± 1.01 and 4.63 ± 0.88 cm in the full-response group and 5.43 ± 1.58 and 3.98 ± 1.18 cm in the partial-response group over pretreatment measurements. The degree of subcutaneous fibrosis in relationship to the duration of the edema appeared to influence results greatly. The treatment of lymphedema with SEP and compression stockings is associated with long-term maintenance of reduced limb girth in 90% of patients.



TITLE: INTERMITTENT PNEUMATIC COMPRESSION EFFECT ON ECCENTRIC EXERCISE-INDUCED SWELLING, STIFFNESS, AND STRENGTH LOSS

Authors: Chleboun et al.

Affiliations: Ohio University School of Physical Therapy, College of Osteopathic Medicine, Athens 45701, USA

Source: Archives of physical medicine and rehabilitation. 1995; 76(8): 744-749

ABSTRACT:

Objective:

The purpose was to determine if intermittent pneumatic compression (IPC) affects muscle swelling, stiffness, and strength loss resulting from eccentric exercise-induced injury of the elbow flexors. We hypothesized that the compression would decrease swelling and stiffness.

Design:

Repeated measures design with a before-after trial comparison within each day.

Setting:

Conducted at a university Somatic Dysfunction Laboratory.

Subjects:

Twenty-two college women students were studied. They had not been lifting weights or otherwise participating in regular arm exercise for the 6 months before the study. They had no history of upper extremity injury or cardiovascular disease.

Interventions:

Subjects performed one bout of eccentric exercise at a high load to induce elbow flexor muscle injury. Uniform IPC was applied on the day of exercise and daily for 5 days at 60mmHg, 40 seconds inflation, 20 deflation for 20 minutes.

Main outcome measures:

Measurements of arm circumference, stiffness, and isometric strength were recorded before exercise, then before and after IPC for 5 days after exercise. Passive muscle stiffness was measured on a device that extends the elbow stepwise and records the torque required to hold the forearm at each elbow angle.

Results:

Circumference and stiffness increased and strength decreased during the 5 days post-exercise ($p < .05$). IPC significantly decreased circumference and stiffness most notably on days 2 and 3 after exercise ($p < .05$). The strength loss was not affected by IPC.

Conclusion:

IPC is effective in temporarily decreasing the swelling and stiffness after exercise-induced muscle injury.



TITLE: LIMB SALVAGE USING HIGH-PRESSURE INTERMITTENT COMPRESSION ARTERIAL ASSIST DEVICE IN CASES UNSUITABLE FOR SURGICAL REVASCLARIZATION

Authors: van Bemmelen P., S. et al.

Affiliations: Department of Vascular Surgery, VA Medical Center, Northport, NY, USA

Source: Archives of Surgery. 2001; 136(11): 1280-1286

ABSTRACT:

Hypothesis:

Intermittent compression therapy for patients with inoperable chronic critical ischemia with rest pain or tissue loss may have beneficial clinical and hemodynamic effects.

Study design:

Case series of 14 consecutive ischemic legs that underwent application of a 3-month treatment protocol during a 2(1/2)-year study.

Setting:

Veterans Administration Hospital.

Patients:

Thirteen patients with 14 critically ischemic legs (rest pain, n = 14; tissue loss, n = 13) who were not candidates for surgical reconstruction were treated with rapid high-pressure intermittent compression. The patients had a mean age of 76.2 years, 8 were diabetic, and they represented 10% of referrals for chronic critical ischemia. They were not amenable to revascularization owing to lack of outflow arteries (n = 7), lack of autogenous vein (n = 5), or poor general medical condition (n = 3).

Intervention:

All patients were instructed to use the arterial assist device for 4 hours a day at home for a 3-month period.

Main outcome measures:

Limb salvage and calibrated pulse volume amplitude.

Results:

After 3 months, 9 legs had a significant increase in pulse-volume amplitude ($P < .05$). These legs were salvaged, whereas the 4 amputated legs demonstrated no hemodynamic improvement. We noted a direct correlation between patient compliance and clinical outcome. Patients in whom limb salvage was achieved used their compression device for longer periods of time (mean time, 2.38 hours a day) compared with those who underwent amputation (mean time, 1.14 hours a day) ($P < .05$). These mean hours of use were derived from an hour counter built into the compression units.

Conclusions:

Intermittent high-pressure compression may allow limb salvage in patients with limb-threatening ischemia who are not candidates for revascularization. Further studies are warranted to assess intermittent compression as an alternative to amputation in an increasingly older patient population.



TITLE: INTERMITTENT COMPRESSION PUMP FOR NONHEALING WOUNDS IN PATIENTS WITH LIMB ISCHEMIA. THE MAYO CLINIC EXPERIENCE (1998-2000)

Authors: Montori V., M., Kavros S., J., Walsh E., E., Rooke T., W.

Affiliations: Division of Endocrinology, Diabetes, Metabolism, Nutrition, and Internal Medicine, Mayo Clinic, Rochester, MN, USA

Source: International angiology. 2002; 21(4): 360-366

ABSTRACT:

Background:

The aim of this retrospective observational study was to review the use of an intermittent pneumatic compression device on nonhealing wounds in patients with critical limb ischemia at Mayo Clinic Rochester.

Methods:

The setting was a community and referral multidisciplinary wound care clinic. The authors analysed 107 patients, median age 73, with critical limb ischemia and active ulcers started using a compression device between 1998 and 2000; 101 patients had lower extremity ulcers, and 25% had a history of amputation, and 64% had diabetes. Of all the wounds, 64% were multifactorial in etiology, and 60% had associated transcutaneous oxygen tension levels below 20 mmHg. Patients were typically asked to use the device at home on the affected limb(s) for 6 hours daily. The main outcome criterion was complete wound healing with limb preservation.

Results:

The median follow-up after initiation of treatment was 6 months. Complete wound healing with limb preservation was achieved by 40% of patients with TcPO₂ levels below 20 mmHg; by 48% with osteomyelitis or active wound infection; by 46% with diabetes treated with insulin; and by 28% with a previous amputation. Half of all amputations occurred in patients with prior amputations. Seven patients discontinued the device because of pain experienced with its use.

Conclusions:

Patients with critical limb ischemia and nonhealing wounds at high risk of amputation can achieve complete wound healing and limb preservation by using an intermittent pneumatic compression device.



TITLE: ELASTIC BANDAGES AND INTERMITTENT PNEUMATIC COMPRESSION FOR TREATMENT OF ACUTE ANKLE SPRAINS

Authors: Ajraksinen O., Kolari P., J., Miettinen H.

Affiliations: Department of PM&R, Kuopio University Central Hospital, Finland

Source: Archives of physical medicine and rehabilitation. 1990; 71(16): 380-383

ABSTRACT:

The efficacy of elastic bandage alone and with intermittent pneumatic compression (IPC) treatments in the rehabilitation of 44 acute ankle sprains was studied. Lower-leg dysfunction was assessed by measurements of edema, degree of ankle motion, pain, and limb dysfunction when the patient was first included in the study, after treatment for one week, and after a four-week follow-up. For all the parameters studied, elastic bandage with IPC treatment resulted in highly significantly (p less than 0.001) faster rehabilitation during the four-week follow-up than did elastic bandage treatment alone. The limb dysfunction improved significantly (p less than 0.01) during the follow-up on the study group receiving IPC with elastic bandage compared to elastic bandage alone. The results suggest that IPC treatment is effective in acute posttraumatic therapy.



TITLE: EFFECT OF INTERMITTENT PNEUMATIC SOFT-TISSUE COMPRESSION ON FRACTURE-HEALING IN AN ANIMAL MODEL

Authors: Park S.- H., Silva M.

Affiliations: Orthopaedic Research Center at Orthopaedic Hospital/ University of California at Los Angeles, Los Angeles, California

Source: The Journal of Bone and Joint Surgery. 2003; 85-A(8): 1446-1553

ABSTRACT:

Background:

The fracture-healing process is closely related to blood supply. Intermittent pneumatic compression of the surrounding soft tissue may alter blood flow and, therefore, modify the healing process. The object of the present study was to evaluate the effect of intermittent pneumatic compression on fracture-healing in an animal model.

Methods:

Unilateral, transverse, mid-tibial osteotomies with a 3-mm gap were performed in thirty rabbits. The osteotomy site was stabilized with a double-bar external fixator. The femoral vein was ligated to induce venous stasis. Beginning on the fourth postoperative day, fifteen rabbits were treated with intermittent pneumatic compression with use of four rubber balloons, two around the distal-part of the calf and two around the mid-part of the calf, for one hour daily for four weeks (the study group) and fifteen rabbits were not treated with intermittent pneumatic compression (the control group). Peripheral computerized tomographic examination was performed biweekly to measure callus area and mineral content at the fracture gap. At eight weeks, the rabbits were killed, and the biomechanical properties of the healing fractures were evaluated with a torsional test.

Results:

An increase in callus area and mineral content at the osteotomy gap was observed in the study group, compared with the values in the control group, starting four weeks after the index procedure. At six weeks, the rabbits treated with intermittent pneumatic compression exhibited, on the average, a 32.2% larger callus area ($p = 0.035$) and a 49.7% higher mineral content ($p=0.01$) at the osteotomy site compared with the values in the control group. The torsional stiffness, maximum torque, angular displacement at maximum torque, and energy required to failure of specimens in the study group were an average of 27.0% ($p = 0.05$), 61.5% ($p = 0.0001$), 35.4% ($p = 0.0003$), and 110.8% ($p = 0.0001$) higher, respectively, than those in the control group at eight weeks.

Conclusions:

Intermittent pneumatic compression enhanced callus mineralization and development and it improved the biomechanical properties of a healing osteotomy site in the rabbit tibia. The use of intermittent pneumatic compression in patients with an acute fracture, especially in the lower limb, may improve bone healing.



TITLE: INTERMITTENT PNEUMATIC COMPRESSION IN CHRONIC VENOUS INSUFFICIENCY FAVORABLY AFFECTS FIBRINOLYTIC POTENTIAL AND PLATELET ACTIVATION

Authors: Kessler C., M., Hirsch D., R., Jacobs H., MacDougall R., Goldhaber S., Z.

Affiliations: Department of Medicine of George Washington University Medical Center, Washington, DC 20037, USA

Source: *Blood Coagulation & Fibrinolysis*. 1996; 7(4): 437-446

ABSTRACT:

Nineteen patients with symptoms of chronic venous insufficiency (CVI) were treated with 13-week cycles of intermittent pneumatic compression (IPC) during 2 h sessions twice weekly, with most treatments at home. At study completion, quantitative subjective scores for total symptomatology were improved in 16/19 patients (84%). Enhancement of fibrinolytic potential in vivo was detected in 86% of observations on specimens from CVI patients over 2 h of IPC, with accelerated euglobulin clot lysis times (ELT) noted within 15 min of initiating compression. The enhanced fibrinolytic potential was attributed to increased urokinase plasminogen activator (u-PA), probably released from perturbed endothelial cells by IPC. Significant decreases in total t-PA antigen (mass concentration) but not t-PA activity, were produced by IPC in CVI patients only ($P = 0.0001$), with greater effects noted in the non-anticoagulated versus the anticoagulated cohort. Plasminogen activator inhibitor type 1 (PAI-1) levels rose rapidly after IPC only in the controls and non-anticoagulated CVI patients. PAI-1 decreased in those receiving anticoagulation. No platelet perturbation was detected during IPC by measuring levels of beta-thromboglobulin or the thromboxane A₂ metabolite, 11-dehydrothromboxane B₂; however, significant ($P < 0.003$) decreases in plasma prostacyclin (PGI₂) levels (measured as the stable 6-ketoprostaglandin F-1- α -metabolite) were observed after 15 min of IPC in non-anticoagulated CVI patients only. There was no evidence of increased thrombin generation by IPC, determined by urinary excretion of fibrinopeptide A and prothrombin fragment 1. Concurrent anticoagulation appears to mediate more favourable biochemical alterations in CVI, although subjective improvement did not correlate with anticoagulation. The mechanism(s) by which these physiologic changes compliment the mechanical effects of IPC remain to be elucidated and will require adequately controlled and powered studies.



TITLE: HAEMODYNAMIC EFFECT OF INTERMITTENT PNEUMATIC COMPRESSION OF THE LEG AFTER INFRAINGUINAL ARTERIAL BYPASS GRAFTING

Authors: Dells et al.

Affiliations: Department of Academic Cardiology, St Mary's Hospital, Imperial College School of Medicine, London, UK

Source: *The British journal of surgery. Obstetrics and gynecology.* 2004; 91(4): 429-434

ABSTRACT:

Background:

Intermittent pneumatic compression (IPC) may increase blood flow through infrainguinal arterial grafts, and has potential clinical application as blood flow velocity attenuation often precedes graft failure. The present study examined the immediate effects of IPC applied to the foot (IPC(foot), the calf (IPC(calf) and to both simultaneously (IPC foot+calf) on the haemodynamics of infrainguinal bypass grafts.

Methods:

Eighteen femoropopliteal and 18 femorodistal autologous vein grafts were studied; all had a resting ankle : brachial pressure index of 0.9 or more. Clinical examination, graft surveillance and measurement of graft haemodynamics were conducted at rest and within 5 s of IPC in each mode using duplex imaging. Outcome measures included peak systolic (PSV), mean (MV) and end diastolic (EDV) velocities, pulsatility index (PI) and volume flow in the graft.

Results:

All IPC modes significantly enhanced MV, PSV, EDV and volume flow in both graft types; IPC (foot+calf) was the most effective. IPC (foot+calf) enhanced median volume flow, MV and PSV in femoropopliteal grafts by 182, 236 and 49 per cent, respectively, and attenuated PI by 61 per cent. Enhancement in femorodistal grafts was 273, 179 and 53 per cent respectively, and PI attenuation was 63 per cent.

Conclusion:

IPC was effective in improving infrainguinal graft flow velocity, probably by reducing peripheral resistance. IPC has the potential to reduce the risk of bypass graft thrombosis.

TITLE: THE EFFECT OF COMPRESSION THERAPY ON VENOUS HAEMODYNAMICS IN PREGNANT WOMEN

Authors: Büchtemann A., S., Steins A., Volkert B., Hahn M., Klysz T., Jünger M.

Affiliations: Department of Dermatology, University Hospital, Tübingen, Germany

Source: British journal of obstetrics and gynaecology. 1999; 106(6): 563-569

ABSTRACT:

Objective:

To study the influence of compression on the haemodynamics of the deep venous system in pregnancy.

Design:

A prospective, observational study.

Setting:

The phlebological unit of the department of dermatology at a university hospital.

Population:

Fifteen pregnant women with no previous signs of chronic venous insufficiency.

Methods:

Parameters of the venous pump function were assessed by strain-gauge plethysmography. Blood flow velocity, flow volume and vessel diameter in the superficial femoral vein were measured by duplex sonography. All examinations were performed with and without applied compression stockings (25-32 mmHg) at two different stages of gestation and after delivery. In addition, subjective symptoms were graded.

Results:

Venous pump function improved and refilling time lengthened significantly when compression was used during gestation and postnatally. Duplex sonography showed an increase in blood flow velocity and flow volume in the superficial femoral vein with applied compression; the vessel diameter increased slightly. Subjective symptoms of the leg, graded on an arbitrary scale, were reduced by regular compression therapy.

Conclusion:

Our results indicate that compression improves the clinical symptoms of venous congestion and the venous haemodynamics of the legs during pregnancy and in the postpartum period. Thus, the regular use of compression during pregnancy and the puerperium may reduce the incidence of thromboembolic events.



TITLE: IMPROVING WALKING ABILITY AND ANKLE BRACHIAL PRESSURE INDICES IN SYMPTOMATIC PERIPHERAL VASCULAR DISEASE WITH INTERMITTENT PNEUMATIC FOOT COMPRESSION: A PROSPECTIVE CONTROLLED STUDY WITH ONE-YEAR FOLLOW-UP

Authors: Delis K., T., Nicolaides A., N., Wolfe H., N., Stansby G.

Affiliations: Irvine Laboratory for Cardiovascular Investigation and Research, Department of Vascular Surgery, Imperial College School of Medicine, St Mary's Hospital, London, UK

Source: *Journal of vascular injury*. 2000; 31(4): 650-661

ABSTRACT:

Purpose:

Intermittent pneumatic foot compression (IPC(foot)) augments arterial leg inflow. It has been suggested that prolonged use of impulse leg compression at home might ameliorate claudication caused by peripheral vascular disease by improving collateral circulation. The purpose of this study was to determine the effect of IPC(foot) treatment on claudication distance and arterial hemodynamics in patients with intermittent claudication caused by peripheral vascular disease.

Methods:

Thirty-seven patients with stable intermittent claudication were admitted to this prospective controlled study. Of these, 25 patients received IPC(foot) (>4 hr/d) for 4.5 months (group 1), and the other 12 patients acted as control patients (group 2). Both groups were advised to exercise unsupervised for a minimum of 1 hour daily and received aspirin (75 mg/d). Groups were matched for age, sex, risk factors, claudication distances, and ankle pressures at baseline. In each patient, initial claudication distance (ICD), absolute claudication distance (ACD), resting ankle brachial index (r-ABI), ankle brachial pressure index after exercise (p-eABI), and popliteal artery volume flow were measured at day 0, 2 weeks, and 1, 2, 3, and 4.5 months. On completion of the treatment period (4.5 months), both groups continued with aspirin (75 mg/d) and unsupervised exercise and were re-examined after 12 months.

Results:

Over the 4.5 months of active treatment, (1) median ICD in group 1 increased by 146% (P <.001), from 78 m (interquartile range, 65-102 m) at baseline to 191.5 m (interquartile range, 127-254 m); ICD did not significantly increase in group 2; (2) median ACD in group 1 improved by 106% (P <.001), from 124 m (interquartile range, 100-160 m) to 255 m (interquartile range, 149-398 m); no significant changes were documented in group 2; (3) median r-ABI in group 1 rose by 18% (P <.001), from 0.57 (interquartile range, 0.48-0.62) to 0.67 (interquartile range, 0.64-0.70); no improvement was noted in group 2; (4) median p-eABI in group 1 rose by 110% (P <.001), from 0.21 (interquartile range, 0.07-0.27) to 0.44 (interquartile range, 0.36-0.52); no changes were noted in group 2; and (5) median popliteal artery volume flow in group 1 improved by 36% (P <.001), from 100 mL/min (interquartile range, 59-163 mL/min) to 136 mL/min (interquartile range, 99.5-173.4 mL/min); no significant changes were found in group 2. At 4.5 months, ICD, ACD, r-ABI, and p-eABI in group 1 were all significantly better than those in group 2 (P <.01). Twelve months' posttreatment, walking ability and ABIs in group 1 were not statistically different from those at 4.5 months and remained significantly better than those of control subjects.

Conclusion:

Intermittent pneumatic foot compression used at home for 4.5 months increases claudication distance by over 100%. Associated increases in r-ABI by 18%, p-eABI by 110%, and arterial calf inflow by 36% suggest an improved collateral circulation. Maximum benefit seems to be offered over the initial 3 months. Treatment benefits are maintained 1 year after treatment. A multicenter study is indicated to quantify actual benefits and to demonstrate cost effectiveness.



TITLE: INTERMITTENT PNEUMATIC COMPRESSION IS EFFECTIVE IN PREVENTING SYMPTOMATIC PULMONARY EMBOLISM AFTER THORACIC SURGERY

Authors: Nagahiro I. et al.

Affiliations: Department of Cancer and Thoracic Surgery, Okayama University Medical School, 2-5-1 Shikata-cho, Okayama, Japan

Source: Surgery Today. 2004; 34(1): 6-10

ABSTRACT:

Purpose:

Postoperative pulmonary embolism (PE) remains a fatal complication even in thoracic surgery. We have used intermittent pneumatic compression for the prophylaxis of postoperative PE since 1998, and herein examined its effectiveness.

Methods:

Seven hundred and six patients, whose medical records showed use/no use of pneumatic compression for prophylaxis of PE, underwent general thoracic surgery in our department from December 1995 to December 2000. Their clinical records were reviewed, and variables were compared between patients who experienced clinically apparent PE and patients who did not have PE.

Results:

Three hundred and forty-four patients did not receive any prophylactic treatment, and 7 of these (2.0%) experienced postoperative PE. Three hundred and sixty-two patients received prophylactic pneumatic compression and none of these developed PE. There was a statistical correlation between the occurrence of PE and the application of pneumatic compression (X²-test, $P = 0.006$). Six of the seven patients with PE were operated on in the right decubitus position, and the operative position and the prevalence of PE was also significantly correlated (x²-test, $P = 0.024$). Other factors, such as age, sex, operative time, duration until patients became fully ambulatory, body mass index, and character of the disease, did not have significant correlation with the occurrence of PE.

Conclusions:

Pneumatic compression was found to effectively prevent postoperative PE. The right decubitus position is considered to be a risk factor for the development of postoperative PE in thoracic surgery.

