Usefulness of intermittent pneumatic compression in medicine

Edyta Sutkowska
Department and Division of Medical Rehabilitation, Wroclaw Medical University, Wroclaw, Poland

doi: 10.1515/physio-2016-0010

Short title: Intermittent pneumatic compression

Abstract
Exist many studies documenting the use of intermittent pneumatic compression in lymphedema, venous ulcers, prophylaxis in deep vein thrombosis and limb ischaemia. This article discusses the basics and usefulness of this therapy based on available studies and recommendations. Because of lack serious side effects, good patient compliance and effectiveness intermittent pneumatic compression should be take into consideration as an alternative or additional treatment in many conditions.

Key words: intermittent pneumatic compression, chronic venous insufficiency, lymphedema, critical limb ischemia

In a XXI century physiotherapy is a very difficult academic discipline due to the dynamic development of different branches of medicine witch have displaced physiotherapy from its traditional role in a treatment of patients. Undoubtedly this is a discipline which requires patience from both therapist and patients, witch in today’s fast paced life may be difficult to accept especially by patients. Finally, the efficacy of some form of physiotherapy is undermined because of lack of EMB (Evidence Based Medicine) support, which in accordance with current knowledge forms the basis of implementing proper therapy, inclusion into the guidelines as well as being a condition for reimbursement of services by the national heath service. Meanwhile, the increasingly elderly society presents a new challenge to physiotherapist due to numerous chronic illnesses which required multiple drug therapy with its many side effects. While physiotherapeutic procedures lack serious side effects and maybe performed multiple times, because there is no special contraindication to the application.

One of the established therapies is IPC (Intermitted Pneumatic Compression), which originates in the XIX century [1]. There exist many studies documenting the use of this technique in different illnesses. The overwhelming majority of these are characteristic for advanced age.

Mechanism of action
Currently in the majority of countries IPC is most often performed in the therapy of lymphoedema or venous ulceration, possibly in the treatment of significant edema due to veno-lymphatic etiology. These indications result from its mechanical as well as systemic effects. During the device’s action the pump successively inflates and deflates the cuff to promote the return of blood from the tissues. Pressure applied externally is transferred to deeply situated tissues and in this way moves retained fluids from subcutaneous tissues, venoulves and small lymphatic vessels to larger vessels and finally into the main vascular trunks from which the fluids are directed towards the heart. On the other hand the provoked temporally ischemia of the skin, during the compression phase, results in hyperemia due to the mechanism of reactive vasodilatation which increases blood flow to the peripheral arteries [2–7]. In this way (reduction of venous pressure with increase of arterial pressure) [8] the arterial-venous pressure gradient increased, which improves the perfusion of the tissues with improve oxygenation and nourishment [9–11]. Besides described mechanism of action this form of intermittent compression also affects coagulation and is responsible for releasing many substances beneficial to the vessel walls [4, 12–16].
Chronic venous insufficiency

Due to the above described reasons IPC is not considered controversial in the treatment of venous insufficiency, mainly active venous ulcers and in VTE (Venous Thromboembolism) prophylaxis as well as lymphatic insufficiency [13, 17–24]. The lack of consensus in regards to recommendations for treatment of venous ulceration is a result of differences in variables across many studies such as: different pressures used in the therapies, the duration of inflation and deflation time and its proportions, different number of chambers used, differences in total duration of the therapy, variable advancement of the disease (total area of the ulcer). A separate problem is small sample size. Despite these problems the analysis of randomized controlled trials (RCTs) suggest that IPC may increase healing compared with no compression, especially if is applied as a additional procedure [25].

Venous thromboembolism prophylaxis

The above mentioned positive effects of IPC on the coagulation system through improving at least two of three elements in Virhoff’s triad (increasing venous blood flow velocity and reversing hypercoagulability by moderating procoagulant activity through elevation of D-dimer), resulted in its acceptance in the prophylaxis of VTE in a select group of patients. The American College of Chest Physicians (ACCP) recommended mechanical methods (foot or low leg pneumatic pump) alone primarily in patients at high risk of bleeding [26] and because of its extra benefit, as an additional modality for the prophylaxis for patients after orthopedic surgery [27–30]. The same indication could be find in Polish guidelines [31].

Complete Decongestive Therapy

In the treatment of lymphedema, despite the lack of consensus [32–39] regarding additional benefits of IPC, it is an integral part of complete decongestive therapy (CDT). This comprehensive therapy is useful in the treatment and prevention of the lymphedema after breast cancer surgery but its also effective in each case of lymphedema not only because of its action but also due to good patient compliance. Serious complications are rare although skin bullae, itching from the compression pad and other minor complication have been reported.

Understanding the pathophysiology of lymphedema and venous or lymphatic insufficiency as well as knowing risk factors for DVT (Deep Vein Thrombosis) the use of IPC is widely accepted. Due to this, despite limited access to the device, awareness of IPC therapy in the above described conditions is quite large.

Sports injuries

Because of the edema, which is the cause of pain and my be responsible for the further destruction of tissues IPC is the physical method often used in sports medicine and is an element of the RICE (Rest, Ice, Compression, Elevation) method used in treatment acute injures [40].

Critical limb ischaemia

Other potential indications are unfortunately less appealing to physicians and physiotherapists. The effect is that in many countries, including Poland, IPC is not only not indicated but is actually contraindicated in the treatment in diabetic foot or limb ischemia. This misunderstanding and lack of knowledge regarding the benefits of IPC deprives many patients of the possibility of optimal treatment.

Reduction of edema, anticoagulant action as well vasodilatation resulting from nitric oxide (the most powerful vasodilatory substance) [41] release should entice physicians to wider use of IPC in cases of critical limb ischemia and diabetic foot (naturopathic and with insufficient blood flow) [42]. Undeniable benefit of IPC is the significant reduction in pain in these patients. Much evidence exist conforming the efficacy of IPC in the group of patients who have no surgical (revascularization) option [8, 43–49]. A variation of rubber calf therapy could be plastic device-circulator boot [50, 51]. It is also used to apply active substances i.e. antibiotics locally. According
to the benefits reported by some authors we can also consider application of this therapy as an additional procedure in patients with claudication [16, 52, 53]. This refers to the patients who can not be properly treated by traditional method- walking exercise (i.e. due to rheumatoid arthritis).

In the literature can be found individual reports about reduced risk of amputation and improved healing after revascularization procedure in patients in which IPC was used [54]. Patients with cholesterol embolism may also derived benefits from this treatment [55].

Despite unsatisfactory conclusions (low-quality evidence) of two independent authors of the systemic review [44, 43] about IPC implementation in ischemic legs, we should remember however that there is no alternative therapy for patients, who do not qualify for revascularization procedures and suffer from rest pain and/or ischemic ulceration.

Summary

In summary as a primary or supplementary treatment IPC seem to be relevant alternative in treating chronic venous and lymphatic insufficiency as well as, paradoxically, limb ischemia. Additionally acute states such as limb injury or cholesterol embolism should also make us consider including IPC in the treatment.

The described method because of low cost as well as its ease of application can be implemented as in hospital or an ambulatory setting, including by properly trained patients at home. The possibility of multiple application as well as almost complete lack of side effects make a strong argument for including this treatment in chronic therapy.

References:


Alvarez OM, Wendelken ME, Markowitz L, Comfort C. Effect of high-pressure, intermittent pneumatic compression for the treatment of peripheral arterial disease and critical limb ischemia in patients without a surgical option. Wounds 2015, 27(11), 293–301.

Dillon RS. Fifteen years of experience in treating 2177 episodes of foot and leg lesions with the circulator boot. Results of treatments with the circulator boot. Angiology 1997, 48, S17–34.


Correspondence address
Edyta Sutkowska
Department and Division of Medical Rehabilitation
Wroclaw Medical University
Borowska str. 213
50-556 Wroclaw, Poland
e-mail: edytasutkowska@yahoo.com