Importance and Advantages of Intermittent External Pneumatic Compression Therapy in Venous Stasis Ulceration

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Venous ulcers are seen following postthrombophlebitic syndrome with venous insufficiency and can begin as a result of minor trauma. In this retrospective study the authors examined the value of external intermittent pneumatic compression therapy in chronic venous ulcers. Results in 1,250 patients with postthrombophlebitic syndromes, 235 of these patients with leg ulcers, revealed that this modality of therapy shortens the therapy duration, lowers the total therapy cost, and hastens the return to active life in comparison to the classical therapy with compression stockings and antiaggregant or low-dose oral anticoagulant therapy. In the light of their findings they propose the wider use of this adjuvant therapy.

Introduction

Deep venous thrombosis (DVT) of the lower extremity is a common complication resulting from prolonged bed rest or immobilization of the limbs. Also DVT accounts for perioperative morbidity and death in up to 30% of trauma, orthopedic, and neurosurgical procedures and has a significant morbidity in all aspects of surgical and oncologic care.[1] The 2 major complications of DVT are pulmonary embolism and chronic venous insufficiency. Advanced chronic venous insufficiency manifested by eczematous skin changes, leg swelling, and ulcer is generally treated with pharmacologic and by mechanical means (elastic stockings and external intermittent pneumatic compression [EIPC]) and by skin and wound care.[2] In the majority of cases this therapy will relieve symptoms and promote healing of venous ulcers if the patient compulsively follows this regimen. Recurrence of ulcers and other symptoms is possible. In the development of lower extremity chronic venous ulcers, the inadequacy of venous valves, the resulting venous stasis characterized by a rise in the tissue pressure, and edema formation due to the ineffective calf muscle pump play the major role.[3,4] The development of venous ulcers in the course of postthrombophlebitic syndrome, which is already restrictive to the patient in itself, renders the patient unable to work during its long-term therapy.[5,6] Intermittent pneumatic compression devices compress the leg for a few seconds of each minute. The compression collapses the veins, which increases venous blood flow during the period of pulse. Compared with traditional thera-

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py, EIPC lessens the risk of bleeding in the immediate recovery phase. In this study, we emphasize the role of external intermittent pneumatic compression therapy in relieving the venous stasis, hastening the healing of ulcers, and thereby lowering the loss of labor power, if used as an adjuvant to the classical therapy.[7]

Materials and Methods

We reviewed the clinical follow-up records of 1,250 patients, who were admitted for postthrombophlebitic syndrome between January 1990 and December 2001. Time intervals between the onset of symptoms and admission, the evidence of ulcers and their duration, the therapy methods applied and their duration, and success were recorded.

Classical therapy consist of elevation of the leg, compression with elastic stockings, oral antiaggregant therapy, and/or, in acute cases, oral or intravenous anticoagulant therapy (eg, heparin and warfarin) and local antimicrobial dressings with systemic antibiotic therapy in cases of ulcers.

External intermittent pneumatic compression was applied using a Huntleig Healthcare Flowtron Plus AC 2002 model compressor and special full leg cuffs. Therapy was planned in 10-day sequences, 1 hour per day, in addition to compression stockings. Maximal pressure was set to 70 mm Hg and the compressor was adjusted to reach the target pressure in 20 seconds and remain there for 20 seconds. To prevent any interference with circulation, 20-second relaxation periods are interspaced.

Results

The patient population is summarized in Table I. The onset of symptoms was dated to less than 1 year in only 345 of the 1,250 patients, whereas the mean time reached was 3.5 years (7 months to 22 years). In the group of patients with less than a 1-year history, there were no ulcers and simple elastic stockings made active life possible. Among the latecomers, 235 patients presented with venous ulcers (18.8% of the total patient population). In 176 of those patients, the ulcer history dated back to more than 3 months. Also, among the latecomers, 19 new ulcerations developed during the classical therapy. Of a total of 235 patients with ulcers, the last 76 were treated with Flowtron as an adjunct to the classical therapy on an ambulatory basis.

In the classical therapy group, the mean time to the disappearance of ulcers was 3 months with a range of 20 days to 5 months and 10 patients needed skin grafting. In the Flowtron group, the mean therapy time was 20 days in a range of 15

Table I. Patient population.

Patient Population		Women	Men	Total
No. of Patients		450	800	1250
Mean age		42 (25–56)	55 (27–62)	50 (25–62)
History	Less than 1 year	235	110	345
	More than 1 year	215	690	905
Ulcer	Less than 3 months	14	45	59
	More than 3 months	20	156	176
New ulcer formation		3	16	19

Table II. Methods and duration of therapy.

Therapy Method	Patients	Response to Therapy	Time	Return to Active Life
Classical	159	149 cure, 10 skin grafts	3 months (20 days–5 months)	Mean 25 days
Flowtron	76	76 cure	20 days (15–35 days)	At the end of first week

to 35 days. All patients returned to active life by the end of the first week, whereas in the classical therapy group this took 25 days (Table II).

Discussion

Chronic venous insufficiency is a widespread, serious, and underestimated problem. It has been estimated to occur in 10% to 35% of the general population and is the most common cause of leg ulceration. Browse et al[8] have calculated that 1% of the population have had leg ulceration at any one time. Women appear to be affected twice as much as men. The mean age of presentation for women is 55 years, and 10% of patients are hospitalized once or more for recurrent thrombosis, venous ulcerations, cellulitis, or lipodermatosclerosis.[9] The majority of cases are considered to be late sequelae of deep venous thrombosis, hence, the term *postphlebitic syndrome.* Chronic venous insufficiency of the deep venous system can be classified into 3 categories; obstruction of large veins, valvular insufficiency, and a combination of these. Class III chronic venous insufficiency, ulcer, swelling, and skin changes are more commonly associated with involvement of the deep venous system.

The natural history of deep venous thrombosis is recanalization of the involved vein with destruction of valves. When the recanalization process is incomplete and collateral vessel formation is inadequate, functional obstruction results. Patients with obstruction of the deep system generally present with marked edema and severe leg pain following exercise (venous claudication). Pulmonary embolism and postthrombotic syndrome are the 2 major complications of deep venous thrombosis. Browse et al[8] concluded that the development of the postthrombotic syndrome was unpredictable.

Szanro et al[10] found that deep venous incompetence correlates well with symptomatic chronic venous insufficiency. Yao et al[11] believe that deep and perforating valve incompetence together are the most important factors in symptomatic deep venous insufficiency.

Chronic deep venous insufficiency leads to chronic venous hypertension; the increased venous pressure is transmitted to the venules and the pathologic process affects the skin and subcutaneous tissues. In chronic venous insufficiency the capillary network is altered. The increased exchange surface is due to elongation and dilatation of the capillaries, which assume a glomerular-like appearance with thickening of the capillary wall. The increased hydrostatic pressure in the microcirculation causes the edema. Other symptoms are dermatitis, induration, local pain, and ulceration, usually localized at the perimalleolar region. Incompetence of the perforating veins' valves transmits the pressure in the deep veins directly to the microcirculation and subcutaneous tissue. An increased escape of fibrin acts as a barrier to diffusion of oxygen, nutrients, and metabolites, leading to cellular ischemia and ultimately to necrosis.[12]

Ulcerations due to chronic venous insufficiency are slow to heal and generally recurrent if the cause of venous hypertension is not removed. Standard treatments of chronic venous disease after deep venous thrombosis are thrombolytic

therapy, elastic stockings (30 to 40 mm Hg of compression), and intermittent pneumatic compression therapy. Selective antibiotics or antibacterial solutions are indicated only for bacterial contamination. Such patients are usually treated with repeat hospitalization. However, many patients have recurrent symptoms on the basis of chronic inactive postthrombotic disease. Patients with predominant venous outflow obstruction are particularly prone to develop recurrent leg pain with exercise, the so-called venous claudication. If recurrent active thrombosis is present, the patient requires anticoagulation. Patients with leg pain, stasis dermatitis, and ulceration are usually managed with elastic support stockings, leg elevation, and intermittent pneumatic compression therapy. Some patients with extensive deep venous outflow obstruction may require venous reconstruction or bypass procedures. Skin grafting may be a necessity for some patients with extensive ulcerations.

External pneumatic compression therapy benefits by collapsing the superficial venous system and forcing blood into the deep system and thus increasing subcutaneous pressure, thereby preventing the leakage of blood, fibrin, and protein from the skin capillaries. In addition to the hemodynamic effect of EIPC, enhancement of fibrinolysis has been postulated to be important.[13] Jacob et al[14] found that EIPC causes significant changes in systemic fibrinolysis. The resulting circulatory improvement not only increases the flow of oxygenated blood to the tissues but also removes potentially harmful toxic wastes.

In many countries the management of patients with leg ulcers depends on community services and primary care teams, although some patients are subject to long periods of hospitalization. It is now realized that vast sums of money are lost through absenteeism, hospitalization expenses, the various medications and dressings used, and, in particular, the extensive nursing time involved. According to recent estimates the annual cost of venous ulceration is approximately DM 400 million in Germany, and more than £150 million in Britain. Thus from both the socioeconomic and medical points of view, quick improvement for these patients is needed for a return to active social life. Hence, we believe that external intermittent pneumatic

Figure 1. Venous ulcer before Flowtron therapy.

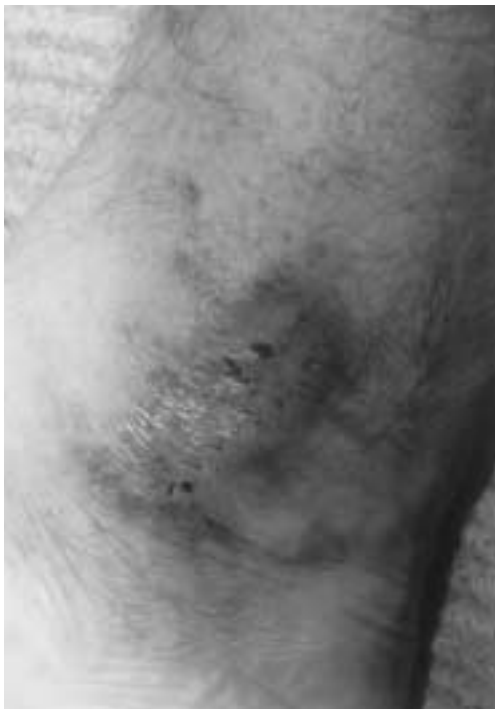

Figure 2. Venous ulcer after Flowtron therapy (after 20 days).

compression therapy is beneficial for attaining rapid and complete cure in venous stasis ulceration (Figures 1, 2)

Conclusion

Venous ulcers were traditionally treated with elevation, compression stockings, and local dressings. Our findings indicate that the adjunctive use of external pneumatic compression therapy lowers the therapy costs by shortening the therapy, decreases the need for antibiotics, and makes an active life possible earlier. It also enhances the comfort of the patients. External intermittent pneumatic compression is efficacious in removing edema and improving oxygen transport and better healing. All these benefits encourage the wider application of this therapy.

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