# A Conventional Compression Bandage Lacks Effect on Subcutaneous Blood Flow when Walking and during Passive Dependence in Chronic Venous Insufficiency

JOHANNES K. KRISTENSEN, JENS HEIN SINDRUP, LARS JELSTRUP PETERSEN, KURT PETERS and LIS DANIELSEN

*Department of Dermatology, Bispebjerg Hospital, University of Copenhagen, Copenhagen, Denmark*

**Blood flow in subcutaneous tissue of the lower leg decreased by 45% on changing from recumbency to the sitting position in patients suffering from chronic venous insufficiency. When walking, blood flow increased significantly to values near those measured during resting recumbency. A conventional elastic compression bandage (Weromedium) had no effect on these parameters, indicating that therapeutic gain through compression is not mediated by an improvement in subcutaneous blood flow.** ***Key word: Elastic compression.***

(Accepted February 18, 1991.)

Acta Derm Venereol (Stockh) 1991; 71: 450–451.

J. K. Kristensen, Section of Dermatology 138, Hvidovre Hospital, University of Copenhagen, Kettegaard Alle 30, DK-2650 Hvidovre, Denmark.

Lower leg venous ulceration appears to be caused by increased venous pressure when standing upright and during exercise, which causes microcirculatory changes leading to impairment of oxygen delivery to the target tissues. In the upright position, central baroreflex impulses and the local sympathetic venoarteriolar reflex cause vasoconstriction in the tissues of the leg (1). Starting exercise in the upright position, vein-pump activation tends to restore central venous pressure and blood volume. A decrease in baroreceptor activity and a decrease in leg venous pressure would hypothetically tend to alleviate vasoconstriction in the legs and blood flow would be expected to increase relative to the passive upright situation (1). This hypothesis has recently been confirmed in a preliminary investigation (2).

The present investigation was performed in order to test the effect of a compression bandage on blood flow when walking and during passive dependency. The hypothesis to be tested was that a compression bandage causes an increase in blood flow during these manoeuvres in patients suffering from chronic venous insufficiency.

## MATERIALS AND METHODS

Subcutaneous adipose tissue blood flow was measured in the lower leg of 21 patients suffering from chronic venous insufficiency and ulceration. All patients had insufficient communicating veins in the lower leg, as evidenced by ascending phlebography and all had systolic toe blood pressure > 60 mmHg and ankle/arm blood pressure index >0.9, thus excluding arterial disease as a factor contributing to the development of ulceration. Fifteen patients had unilateral ulceration, and 6 patients were suffering from bilateral ulcers. Ages ranged between 34 and 89 years (mean age 72). Ten male and 11 female patients were investigated. Blood flow was measured using the $^{133}$Xenon washout technique, portable CdTl (Cl) detectors and a portable data storage unit (Memolog®) as previously described (3). The tracer depot was applied to the lateral aspect of the lower leg, 10 cm proximal to the malleolar level, or just proximal to the ulcerated area. An atraumatic labelling procedure was employed.

Washout from the tracer depot was recorded with the patients 1) supine (10 min), 2) sitting with passively dependent legs (15 min), 3) supine (10 min), 4) walking (15 min) and finally 5) supine (10 min). This procedure was performed with and without a conventional elastic compression bandage (Weromedium) applied to the leg under study. This bandage applies a local pressure of approximately 20 mmHg. The patients were randomized to two groups, one being measured initially without compression and the second group initially with compression applied. The washout rate constants ($k$) for each washout curve segment were computed and relative blood flow during sitting and walking was calculated.

The subcutaneous blood flow (SBF) can be calculated from:

$$\text{SBF} = \lambda \times k \times 100 \text{ ml} \times (\text{min} \times 100 \text{ g})^{-1} \qquad (1)$$

Lambda denotes the tissue-blood partition coefficient. Assuming $\lambda$ to be constant throughout the measurements, relative changes in the washout rate constant ($k$) reflect relative changes in SBF.

Relative blood flow during sitting and walking (RSBF) was calculated as

Table I. *Median values of relative subcutaneous blood flow during sitting (S) and walking (W). k (ref) is the resting supine washout rate constant ($min^{-1}$).*

*P*-values comparing sitting and walking and ± compression are shown. The 95% confidence limits are shown in parentheses.

| | Without compression | With compression | *P*-value |
|---|---|---|---|
| RSBF (S) | 0.51<br>(0.41–0.64) | 0.56<br>(0.33–0.59) | 0.73 |
| RSBF (W) | 0.85<br>(0.57–1.12)<br>p = 0.003 | 0.76<br>(0.55–0.98)<br>p = 0.007 | 0.16 |
| *k* (ref) | 0.008<br>(0.004–0.012) | 0.0099<br>(0.005–0.013) | 0.93 |

$$\text{RSBF} = \frac{k\ (\text{test situation})}{(k\ \text{ref (before test)} + k\ \text{ref (after test)}) \times 1/2} \qquad (2)$$

Differences between washout rate constants obtained sitting versus walking, or relative blood flow differences with versus without the bandage were compared by the non-parametric Wilcoxon matched pairs test.

## RESULTS

The results are shown in Table I. Blood flow decreased during passive dependency and increased significantly during walking, compared with the passive leg. No statistically significant differences between measurements with vs. without compression were found.

## DISCUSSION

We have recently shown that healthy persons and patients suffering from chronic venous insufficiency were able to increase their lower leg subcutaneous blood flow during walking as compared with the blood flow observed in passively dependent (dangling) legs (2). The same was found in the sample of patients investigated in the present study. Furthermore, the local circulatory adjustments to posture and exercise were not influenced by bandaging of the legs.

The sustained high venous pressure observed in these patients is probably the main pathophysiological factor in the formation of edema, fibrosis and ulceration (3). The mechanisms involved in the development of ulceration are poorly understood. The present results do not support the theory of a continuing activation of the venoarteriolar reflex resulting in a decreased blood flow during walking as being a major pathogenetic factor (4). The present investigation did not exclude the possibility of a decreased oxygen extraction as contributing factor (5).

## ACKNOWLEDGEMENTS

We wish to thank Mrs Birthe Christiansen for skilful technical assistance, and Coloplast A/S for providing this assistance and the Memolog® instrument.

## REFERENCES

1. Rowell LB. Cardiovascular aspects of human thermoregulation (Review). Circ Res 1983; 52: 367–379.
2. Peters K, Sindrup JH, Petersen LJ, et al. Lower leg subcutaneous blood flow during walking and passive dependency in chronic venous insufficiency. Br J Dermatol 1991; 124: 177–180.
3. Christopoulis D, Nicolaides AN, Cook A, et al. Pathogenesis of venous ulceration in relation to calf muscle pump function. Surgery 1989; 106: 829–935.
4. Dodd HJ, Gaylarde PM, Sarkany I. Skin oxygen tension in venous insufficiency of the lower leg. J R Soc Med 1985; 78: 373–376.
5. Gowland Hopkins NF, Spinks TJ, Rhodes CG, Ranicar ASO, Jamison CW. Positron emission tomography in venous ulceration and liposclerosis: study of regional tissue function. Br Med J 1983; 286: 333–336.