Maximal cutaneous blood flow in vibration white fingers

F BOUVIER, C-J GÖTHE, L-E LINDBLAD

From the Departments of Clinical Physiology and Occupational Medicine, Södersjukhuset, S-100 64 Stockholm, Sweden

Long term work with vibrating tools often results in attacks of cold induced reduction of the blood flow in finger arteries ("vibration white finger"—VWF).¹ Organic obstruction of the digital arteries due to hypertrophy of the vessel walls^{2,3} and subintimal fibrosis⁴ have been proposed as a possible pathophysiological mechanism. With plethysmographic methods, however, similar maximal blood flows are observed in VWF fingers as in normal fingers of workers not exposed to vibration.¹ Plethysmography measures the total rather than the cutaneous blood flow and the aim of the present study was to examine the maximal superficial cutaneous blood flow in VWF and normal fingers.

Material and methods

Eleven otherwise healthy patients with VWF corresponding to grades 3 and 4 according to the Taylor and Pelmear symptom scale⁵ were studied. The mean age of the patient group was 44.5 years (range 25-61). The controls were 11 male white collar workers without vascular disease individually matched to the patients with regard to age (± 5 years) and nicotine habits (users, non-users).

In every patient the most and least affected fingers, and in the controls one of the three medial fingers, were examined. The blood flow in the fingers exposed in ml/minute and 100 g tissue was measured according to Sejrsen.⁶ On the dorsum of the middle phalanx, 0.2 ml of ¹³³Xe dissolved in physiological saline (1388 MBq/ml) was applied in a water and gas proof chamber attached to the finger with plaster. The skin was exposed to the ¹³³Xe-solution for three minutes to allow a small Xe-fraction to penetrate into the cutis. The chamber was then removed and the skin cleaned by gentle wiping. The elimination of ¹³³Xe was measured with a gamma detector (Mini Scaler MS-2, Eberline Instrument Corp). The wash out rate of ¹³³Xe gives a measure of the cutaneous blood flow.

The measurements were performed with the subjects in supine position and their hands located at heart

level. The room temperature was $27^{\circ} \pm 1^{\circ}\text{C}$ and the finger temperatures ranged between 33° and 36.5°C . Before the first blood flow measurement, vasodilation was induced with oral intake of 5 cl of 50% ethanol combined with indirect heating of the abdomen for 20 minutes. After this, arterial occlusion was applied on the examined finger for three minutes, and during the phase of postocclusive vasodilation another estimation of blood flow ("maximal cutaneous blood flow") was done.

Results

Before arterial occlusion there is a numerical but statistically non-significant ($p > 0.05$) tendency to lower blood flow in the most affected VWF fingers as compared with the least affected VWF fingers and control fingers (table). During the postocclusive vasodilation, the mean flows are about the same in both VWF and control fingers.

Discussion

After vasodilation the cutaneous blood flow of the fingers is the same in patients with VWF as in healthy subjects which corresponds to earlier findings using plethysmographic methods.¹ The means are similar in all groups. Consequently, it is unlikely that a real difference is masked by the variation.

The observation that the cutaneous blood flow during intense vasodilation is about the same in VWF

Cutaneous blood flow (ml/minute and 100 g tissue) in fingers of patients with VWF and in fingers of white collar workers without vascular disease (mean $\pm$ SD)

	VWF fingers		
	Most affected (n = 11)	Least affected (n = 11)	Control fingers (n = 11)
Before postocclusive vasodilation	20.4 $\pm$ 8.56	28.1 $\pm$ 12.8	27.7 $\pm$ 13.03
After postocclusive vasodilation	75.5 $\pm$ 34.90	82.5 $\pm$ 40.49	75.6 $\pm$ 16.04

fingers as in non-affected fingers of subjects not exposed to vibrations further confirms that the attacks of reduced blood flow in VWF are mainly due to reversible vasospasm.

References

- 1 Ekenvall L, Lindblad LE, Bevegård S, Etzell BM. High vascular tone but no obliterative lesions in vibration white fingers. *Am J Ind Med* 1986;**12**:47–54.
- 2 Pyykkö I, Hyvärinen J. Vibration induced changes of sympathetic vasomotor tone. *Acta Chir Scand* 1976;suppl 465:23–6.
- 3 Takeuchi T, Futatsuka M, Imanishi H, Yamada S. Pathological changes observed in the finger biopsy of patients with vibration induced white finger. *Scand J Work Environ Health* 1986;**12**: 280–3.
- 4 Hashimoto K, Craig RS. Acroscclerosis associated with vibration: an electron microscopic study. *J Cutan Pathol* 1980;**7**:373–86.
- 5 Taylor W, Palmear PL. Raynaud's phenomenon of occupational origin. An epidemiological survey. *Acta Chir Scand* 1976;**20**: 27–32.
- 6 Sejrnsen P. Blood flow in cutaneous tissue in man. Studied by washout of radioactive xenon. *Circ Res* 1969;**25**:215–29.