

Angiographic study of digital arteries in workers exposed to vinyl chloride

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ABSTRACT Five patients exposed to vinyl chloride were studied by hand angiography and other non-invasive methods, including photoplethysmography, reography, and thermography. Raynaud's phenomenon was present in all five subjects, while acro-osteolysis affected only one. Organic vascular lesions, such as narrowing, segmentary occlusions of digital arteries and bridge collaterals, were found in angiographic studies. Only one patient did not show clear segmentary occlusions, but his vessels were crooked and diffusely narrowed. Angiographic results appear to correlate well with the changes shown by non-invasive techniques.

Vinyl chloride causes a complex syndrome, which may include typical Raynaud's phenomenon. The impairment of vascular system function in vinyl chloride disease has been studied in a small group of subjects by means of plethysmography,¹ thermography,² or angiography.^{3,4}

We were unable to find any published study of all these vascular parameters in the same group of patients.

Materials and methods

Of 30 workers having vinyl chloride disease, five who complained of severe Raynaud's phenomenon were selected for detailed study. The mean age was 46 years (range 31-56); mean working age was 12.6 years (range 5-22). Three worked in a vinyl chloride-polyvinyl chloride polymerisation factory as autoclave cleaners; the other two worked inside polyvinyl resin silos (bunker workers) in the same factory.

The severity of their Raynaud's phenomenon was evaluated by a traumatic vasospastic disease index⁵: in all cases the score ranged from 7 to 10 (that is the highest possible score). All the patients showed pseudoclubbing of the fingers, minimal skin changes, hyperhidrosis, and paresthesiae. Only one subject had bilateral acro-osteolysis of the index finger; he also had scleroderma-like skin changes.

Each patient underwent digital photoplethysmography,⁶ repeated after cold testing⁷ antebrachial and digital reography,⁸ static and dynamic hand

thermography,⁹ and angiography.

Hand angiograms were performed during general anaesthesia. Thirty ml of iodide contrast medium (Urografin 76%) were injected, at 6 ml/s, in the brachial artery on each side; two x-ray films a second for the first five seconds, and one x-ray film a second for the next three seconds were obtained.

A short, deep general anaesthesia¹⁰ was necessary to complete filling of the digital arteries. We used halothane, a vasodilator anaesthetic, to eliminate painful vasospasm after contrast medium injection¹¹; such arterial spasms may mask underlying occlusive disease in patients with Raynaud's phenomenon when the examination is performed under local anaesthesia.¹² In only one patient was the arteriogram performed firstly under local anaesthesia and secondly under general anaesthesia.

All the investigations were carried out in a thermostatically controlled room (21°C).

Results

In the forearms the amplitude of the reogram was reduced in two cases in the basal state; some morphological changes of the descending segment of the sphigmic wave suggested basal vasospasm.

At the fingers during rest four cases showed spontaneous changes of the vascular tone; curves with a wide base and hyperdicrotism, or flattened curves with quickly ascending pulse segment and flatly continuing descending segment, with fairly regular, small waves (saw-waves).

Photoplethysmography showed appreciably flattened curves, with quickly ascending and slowly

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