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POST-TRAUMATIC SYNDROME AND LIMB BLOOD FLOW

A preliminary Investigation

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Fractures in the region of the wrist sometimes cause long functional disability of the joint. Reduced, painful wrist motion is the most frequent symptom. However, in a few cases, classical so-called post-traumatic dystrophy develops with oedema, cyanosis, tenderness, painful, limited motion, and spotty osteoporosis. It has long been claimed that reflexly reduced capillary blood flow and stasis is the main cause of this syndrome (Dubois 1933, Bolliger 1954, Lenggenghager 1956, Thorban 1964). It has been suggested that the initial phase of osteoporosis is an effect of mineral dissolution, which is favoured by tissue acidosis. Though venous occlusion plethysmography has shown that the blood flow is increased in limbs with post-traumatic dystrophy (Miller et al. 1942), this acidosis has been assigned to sluggishness of the blood flow (Bolliger 1954, Lenggenghager 1956).

The present preliminary investigation was undertaken to obtain more objective data about the haemodynamics in post-traumatic dystrophy.

MATERIAL, METHODS AND RESULTS

The blood flow was measured in the forearms of three patients with typical post-traumatic dystrophy after fractures in the carpal region. The blood flow measurements were performed by venous occlusion plethysmography according to Dahn (1965). A water temperature of 34° was used. Room temperature varied between 20-24°. The patients were resting supine for 15 minutes before measurement. The resting

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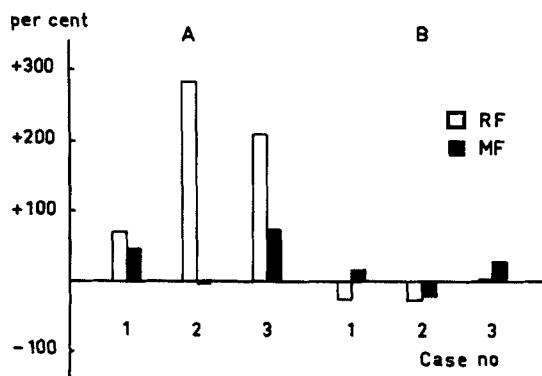


Figure 1. Resting (RF) and maximum (MF) forearm blood flow changes of the injured extremity in per cent of the control arm.

A: Values at the first measurement.

B: Values at the follow-up examination.

blood flow as well as the maximum blood flow after 3 minutes arterial occlusion were measured.

Case 1. 55-year-old workman. On 25 June 1968, the right hand was caught in a drill. X-ray demonstrated a fracture of the scaphoid bone, which was treated with plaster for eleven weeks. Motion of the wrist and humeroscapular joint was afterwards limited; oedema and osteoporosis developed. Intense physical therapy, daily procain infusions, and elevation of the arm was started. Plethysmography showed a 75 per cent increase of the resting blood flow and a significant elevation of the maximum blood flow in the right forearm (Figure 1). Successive recovery was noted. The patient returned to work on 10 March 1969. The motion of the fingers of the right hand was still slightly restricted. At follow-up 22 months after injury no deformity or oedema was seen. The mobility and strength of the radiocarpal and finger joints were normal. There was no pain and the skin temperature was normal. On 10 April 1970, 21 months after injury, the resting as well as the maximum blood flow was the same in both forearms (Figure 1).

Case 2. 48-year-old chamber-maid. On 29 October, 1968, she slipped and hurt her right wrist. X-ray examination showed a Colle's fracture with some dislocation. The fracture was reduced by manipulation under local anaesthesia and the wrist was immobilized in a dorsal plaster splint. The plaster was removed five weeks after the accident. Motion of the wrist and the finger joints was impaired. Physical therapy was started but without effect. X-ray showed pronounced osteoporosis of

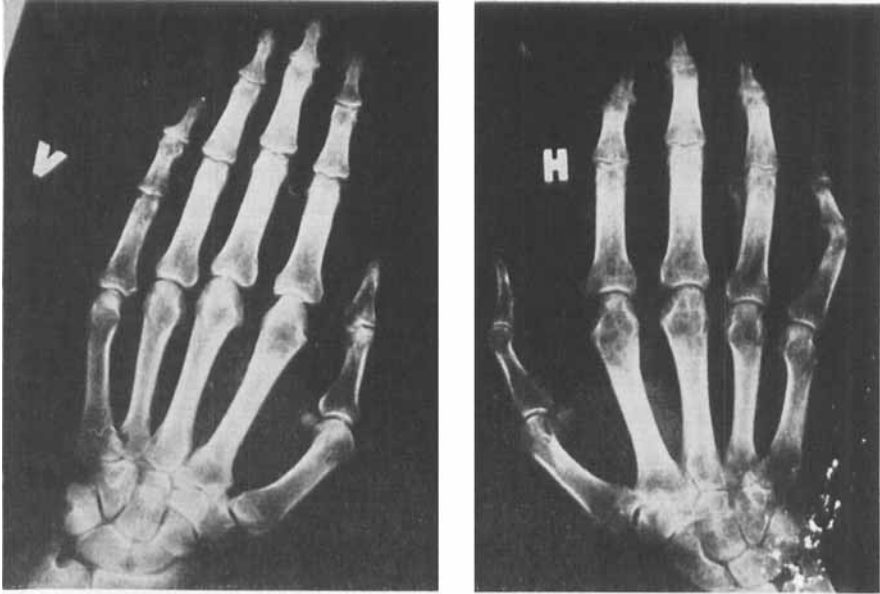


Figure 2. X-ray of the hand skeleton of patient 2. Note the osteopenia of the right injured hand.

the right hand (Figure 2). The patient was then admitted to hospital (13 January to 4 February, 1969) for treatment with procain infusions, elevation of the extremity, and intense physical therapy. Blood flow measurements on 30 January, 1969 showed a fourfold increase of the resting flow through the right forearm. The maximum flow was equal in both forearms (Figure 1). The symptoms gradually disappeared, but the patient did not return to work until 14 November, 1969. Eighteen months after injury the radiocarpal and finger joint were still stiff and painful and the wrist and fingers were weak. The skin temperature was normal and no oedema was demonstrable. Blood flow measurements on 1 April, 1970, 17 months after injury, showed a somewhat lower resting flow in the injured extremity. There was no significant difference between the maximum blood flow through the right and left forearms (Figure 1).

Case 3. On 3 December, 1968, a 46-year-old labourer fell and sustained an intraarticular Colle's fracture on the left side. The fracture was reduced by manipulation under local anaesthesia and was immobilized in a plaster splint for five weeks. Oedema, osteoporosis, and very limited, painful motion were noted; physical therapy was started but

without any demonstrable effect. The patient was therefore admitted to hospital (6 February to 22 February, 1969) where he was treated with procain infusions, elevation of the extremity, and physical therapy. Some improvement was noted. On 6 February, 1969, the resting blood flow in the left forearm was increased threefold. Also the maximum blood flow was elevated in that arm (Figure 1). Continued ambulatory therapy resulted in slow recovery, and the patient returned to work on 14 July, 1969. At follow-up 17 months after injury, there was some limitation of strength and motion of the wrist. There was no pain or oedema and the skin temperature was normal. Blood flow measurements on 2 April, 1970, 16 months after injury, showed normal resting blood flow in both forearms and a slight increase of the maximum blood flow in the injured limb.

DISCUSSION

Venous occlusion plethysmography measures the total inflow of blood into the limb segment inside the plethysmograph. The total blood flow through the forearm in the post-traumatic syndrome is thus elevated after fractures in the region of the wrist. The results of the present investigation support the study by Miller et al. (1942) but seem to be incompatible with the earlier view that the post-traumatic syndrome is a result of capillary stasis.

It is emphasized, however, that an increased total blood flow through a limb segment does not necessarily mean an increased or even normal capillary or nutritional blood flow. On the contrary, in the post-traumatic syndrome, the cold, cyanotic skin and the oedema reflect engorgement of the capillary blood circulation of the skin. In two patients (Case Nos. 1 and 3), however, the maximum blood flow was also increased, which implies an increased capillary flow through the muscles of the forearm in the injured extremity. As the clinical condition improved the total blood flow again became normal.

In this connection it is of interest that in disuse osteoporosis there is an increase of the total blood flow through the extremity (Imig et al. 1953) as well as of that flow through bone (Shim 1966, Semb 1966). It has been suggested that the bone blood flow increase is a result of blood shunting through bone and bone marrow when the venous drainage is impaired by muscle inactivity (Semb 1966). The clinical picture of the post-traumatic syndrome combined with increased total blood flow also suggests a shunt mechanism. Furthermore, disuse osteopo-

rosis is frequently combined with limited joint motion and oedema. As previously pointed out by Geiser (1957), the similarity between the clinical symptoms and blood flow disturbances in disuse osteoporosis and post-traumatic dystrophy suggests a close etiological relationship between the two conditions.

SUMMARY

In a preliminary investigation the forearm blood flow was measured in patients with clinical and radiological signs of post-traumatic dystrophy. The resting blood flow through the forearm was significantly increased in the injured extremity with a successive decrease towards normal values as the clinical condition improved. The similarity between post-traumatic dystrophy and disuse osteoporosis is discussed.

REFERENCES

- Bolliger, A. (1954) Gefässreaktionen und ihre Rolle bei der Entstehung der Sudeckschen Syndrome. *Helv. chir. Acta* **21**, 61.
- Dahn, I. (1965) On clinical use of venous occlusion plethysmography of calf. I. Methods and control. *Acta chir. scand.* **130**, 42.
- Dubois, M. (1933) Über akute traumatische Knochendystrophien. *Arch. orthop. Unfall-Chir.* **32**, 398.
- Geiser, M. (1957) Die Rolle der Muskelaktion bei der posttraumatischen Osteoporose. *Arch. orthop. Unfall-Chir.* **49**, 268.
- Imig, C. J., Randall, B. F. & Hines, H. M. (1953) Effect of immobilization on muscular atrophy and blood flow. *Arch. phys. Med.* **34**, 296.
- Lenggenhager, K. (1956) Neue Anschauungen über Genese und Therapie der akuten kleinfleckigen Sudeckschen Knochendystrophie. *Helv. chir. Acta.* **23**, 309.
- Miller, D. S. & deTakats, G. (1942) Posttraumatic dystrophy of the extremities. *Surg. Gynec. Obstet.* **75**, 558.
- Semb, H. (1966) Plasma clearance of Sr^{85} by bone. An attempt to study the rate of blood flow through normal and immobilized bone in dogs. *Acta Soc. Med. upsalien.* **71**, 227.
- Shim, S. S. (1966) Quantitative studies of factors affecting bone blood flow based on bone clearance of radiostrontium. Diss. Abstr. Univ. Brit. Columbia, Canada. No. 26/7.
- Thorban, W. (1964) Klinische und experimentelle Untersuchungen zur Ätiologie und pathogenese der posttraumatischen Sudeckschen Gliedmassendystrophie. *Acta neuroveg. (Wien)* **25**, 1.