Studies on Peripheral Circulatory Using Radioisotopes

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Gamma camera and a minicomputer system were used for the studies on the peripheral circulatory movement of xenon-133, which was injected in calf muscle of patients, to pursuit of the diffusion and its direction of flow.

Method:

After the injection of xenon-133 (200–800 μCi in 0.5 ml) in calf muscle, the images from gamma camera were recorded on disk-cartridge, displayed the distribution of radioactivity on CRT and also R.O.I. curves were obtained in 2–10 second interval of 20 frames to 60 frames.

Result:

(1) The direction of flow of injected xenon-133 in calf muscle was demonstrated clearly on the CRT-display, and the direction of movement was to the heart of the patient.

(2) The R.O.I. curves showed the same results as displayed on the CRT.

Determinations of Regional Blood Flow in Gangrenous Lesions of Diabetics Using 133Xe and a Scintillation Camera

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We previously reported on the measurement of the mean blood flow and the mean transit time through the capillary bed of the toes of diabetic patients with a scintillation counter, using 133Xe or 99mTc labeled albumin. In the present study, determination of regional blood flow in the foot was made by the AOI method with a scintillation camera VTR on line system.

133Xe saline solution was injected rapidly into the femoral artery of normal subjects and of patients with diabetes mellitus. A collimator equipped with a ratemeter and recorder was placed on the foot, and the changes of 133Xe activities were recorded by the VTR for 30 minutes. Thereafter, the 133Xe clearance curve in each area of interest (AOI) was reproduced from the VTR. The curve was plotted semilogarithmically and was resolved by the peeling-off procedure into three components. The mean blood flow (MBF, ml./min./100 g.) was calculated as follows: MBF=100×λ×km, where λ is the tissue blood partition coefficient and Km is the mean fractional disappearance rate of 133Xe.

Values for the MBF of the toes of diabetic patients with mild neuropathy averaged 11.5±8.5 ml./min./100 g. and were significantly lower then those of the control subjects (Mean ±SD=22.1±5.4 ml./min./100 g. P<0.05). Values for the MBF of the toes of one diabetic patient with severe neuropathy (63.7 ml./min./100 g.) and of three diabetic patients with gangrene or ulcer (30.8,
54.3 and 72.4 ml/min./100 g) were significantly higher than those of the controls. These MBF increases were found to be mainly due to a high flow rate for Component 1. Furthermore, a series of scintiphotos following the $^{133}$Xe injection showed increased MBF in or around the gangrenous and ulcerative lesions at an early phase which corresponded to Component 1. These findings suggested a compensatory increase in MBF in or around the gangrenous and ulcerative lesions at a healing stage.

Studies on Regional Blood Flow of Delayed Deltoplectoral Flap
By Method of Local Clearance of Xenon-133

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The studies on the regional blood flow of delayed deltopectoral flaps using the radioactive inert gas Xenon-133 in 32 patients are reported.

Method:
Xenon-133 dissolved in saline was directly injected to the cutaneous tissue of the deltid region. The clearance curve was recorded continuously by collimated scintillation detector for 30 minutes immediately after the injection.

Results:
The clearance curves replotted semilogarithmically consisted of two exponential components. The clearance rate of the first component showed skin blood flow in the region.

A close correlation between the clearance rate and the age of preoperative patients was found.

The regional blood flow of lining deltopectoral flap was observed higher than that of U-shaped undermining deltopectoral flap.

Reconstructive surgery should be carefully carried out in patients with low clearance rate.

Determination of Muscle Blood Flow of Hemiplegic Patients
Due to Cerebral Vascular Disorders

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Using $^{133}$Xe-clearance method, muscle blood flow was measured to survey the state of the peripheral circulation of the upper extremities of hemiplegic patients at several stages of rehabilitation.