Symposium II.

Dynamic Analysis of Circulation

The Circulation Dynamics of the Spleen Determined by Analysis of Pairs of Radiograms, the Precordium and the Spleen, Using Analog Computer

Y. Takahashi

Hematology Division, Internal Medicine, Tenri Hospital

C. Uyama and T. Soma

Faculty of Engineering, Kyoto University

S. Kariyone

First Division, Internal Medicine, Kyoto University

Because of some complexity presumed to exist in the circulation mode of the spleen, preliminary experiments were carried out to probe its property and to find out the suitable analysis method.

Radiotracer, Tc-99 m albumine, was injected from the arteria into the extirpated dog spleen under perfusion and radiograms of 'input', 'spleen' and 'output' were obtained with three respective detectors. From their analysis results we ascertained that the input-output response function can be determined by analysing the radiosplenogram. Two circulation phases, fast and slow, both developed the property of the first order kinetics system were also detected in the 'output' radiogram.

Double tracing with Tc-99 m albumin and Au-198 colloids and analysis of their respective radiograms brought about the findings which imply that extraction takes place in the first order manner secondary to the flow systems.

Tc-99 m albumin was injected into the celiac artery of an humane normal subject equipped with a scinticamera on his upper abdomen. Radiograms were obtained of 5 horizontally subdivided 'areas of interest', each corresponded to the sections from hilus to periphery of the spleen.

Analysis results indicated that flow characteristics should be represented by transport lag for the artery and vein path and by the first order system for the capillary phase.

Usual clinical experiment were carried out with cylindrically collimated detectors, in which we applied two kind methods to each fast and slow phase. For the slow phase the tracer was injected into the antecubital vein and the radiosplenogram and blood dilution curve were rendered to compartment analysis composed of three ones, general circulation and two different pools in the spleen. On the other hand, the fast phase analysis were carried out with the tracer injected into the celiac artery and the radiograms which were subjected to simulation analysis using an analog computer.

In the latter procedure, the transfer function of heart-lung system to spleen dynamics was computed with a pair of radioprecordiogram and radiosplenogram of intravenous injection. This function was applied to precise evaluation of recirculation component in the radiosplenogram of intraarterial injection, which was determined as an output through the system with the corresponding radioprecordiogram as an input. The first circulation component was then decided by subtracting the recirculation one from the original radiosplenogram. Thus the transfer function of the spleen was reduced.

In eight normals, this function for red blood cells was expressed by the sum of two exponential component, while that for serum albumine was revealed in 4 of them to be of single exponential fashion. As for mean transit time, a statistically

significant difference was observed between red cells and serum albumine, the former being delayed more than the latter.

Results in 7 hereditary spherocytosis revealed that the mean transit time of autogeneous abnormal cells through their own spleen was significantly longer not only than that of normal cells through normal spleen but also than that of normal cells through the same patient's spleen. The time of any red cells was also significantly longer than that of serum albumine.

In the fast circulating path, red cells were sometimes accelerated to pass through and their transport efficiency was indicated to be greater than the plasma, since the rate constant value of exponential component for the fast path was in some cases greater for Cr-51 red cells than that for I-131 H.S.A. .

Circulation of such substances as to be extracted in the spleen, for instance, colloid particles or artificially denaturated red cells, was in some instances to be delayed. This retardation was closely related and preportional to particle size of colloids or to deformation grade of the treated cells and resulted in elevation of extraction efficiency of such substances in a single passage.

The circulation characteristics of the spleen was elucidated more accurately by this detailed analysis, which would provide us more useful imformation concerning patho-physiology of this organ.

Regional cerebral blood flow study in hypertensive intracerebral hemorrhage with ^{133}Xe clearance method

K. Uemura and K. Yamaguchi
Division of Radiology
H. Kawakami
Division of Internal Medicine
Y. Sakurai
Division of Neurological Surgery Research Institute of Brain & Blood Vessels, Akita

Isotope clearance method developed by Lassen and Ingvar now make it possible to acquire quantitative data on regional alterations of cerebral blood flow of several brain deseases, but it does not appear to be a comprehensive evaluation dealing with the regional cerebral blood flow (rCBF) of intracerebral hemorrhage.

The purpose of this paper was to discuss the alteration of rCBF and its regulatory functions tested by Co_2 inhalation and induced change in blood pressure on patients of acute stage of hypertensive intracerebral hemorrhage.

Methods and Materials: Thirty-eight patients with hypertensive intracerebral hemorrhage were examined. The mean duration from onset to the first rCBF studies was 4.4 days(the day of onset —19 days after the onset), the mean interval from the first to second studies was 14.5 days (7 days—21 days) on conservatively treated group, and 13.8 days (7 days—29 days) on surgically treated group.

The rCBF measurement was carried out on six regions of ipsilateral side of the lesion with the ^{133}Xe regional clearance technique. The isotonic solution of 1 mCi ^{133}Xe was injected into the internal carotid artery through a thin polyethylene catheter and the ^{133}Xe clearance curves of the rest stage were measured for 15 min., and then, the response of cerebral circulation to hypercapnia induced by 5% Co_2 inhalation and hypotension induced by intravenous injection of Regitin were examined.

Detector head which used for this study had 6 scintillation probes with 25.4 X 25.4 mm NaI (T1) crystals collimated by 25 mm i.d. X 107 mm long lead cylinder.