Analysis of the Portal Circulation by Analog Simulation of Radiograms Corresponding the Portal System, the Liver and the Heart

Y. TAKAHASHI and K. AKASAKA
Hematology Division in Internal Medicine, Tenri Hospital, Tenri

Y. KURODA and T. TANAKA
Radiology, Tenri Hospital, Tenri

C. UYAMA
Faculty of Engineering, Kyoto University, Kyoto

Circulation dynamics of the portal system was measured in two ways of tracer injection and analysed with analog simulation technique.

In one way, the radiotracer, I-131 or Tc-99m albumin, Cr-51 red blood cells and I-131 M.A.A., were injected successively through a cathether into the celiac artery and radiograms of the spleen, the liver, the precordium and the head were obtained with the cylindrically collimated detectors. In the other, a mixture of Tc-99m albumin and I-131 M.A.A. was injected percutaneously into the spleen of the patient lying supine under a scintilation camera equipped with video tape recorder system. Regions of interest were selected with corresponded to the splenic vein, the portal vein, the collaterals, the liver and the precordium and radiograms of each ‘R.O.I.’ were recorded by playing back from video tape. The same tracers except I-131 M.A.A. were injected again into the antecubital vein and the radiograms were obtained in the same manner as in intrarterial and intrasplenic injection.

The radiograms were subjected to analysis with an analog computer having the circuit constructed in combination of simple time lag and the first or the second order lag filter elements to simulate this circulation system. The transfer function of the heart-lung system to an aimed site was computed by simulating a pair of corresponding radiograms of intravenous injection. The function was applied to determining the received circulation component of each corresponding radiogram of intrarterial or intrasplenic injection and the initial circulation component was then extracted for the analysis to disclose circulation characteristics in this system.

In eight normals who received intrarterial injection, mean transit time of I-131 albumin from that artery to the liver was 16.8±2.8 sec. (mean ±S.D.) and that to the liver was 24.5±4.0 seconds. The transit time for Cr-51 red blood cells was significantly longer in the spleen and shorter through the portal vein and also in the liver not only in normals but also in hemolytic anemias and splenomegalies with portal hypertension.

By intrasplenic injection, sequential scintiphotography delivered the anatomocal informations of the portal vein and the collaterals. With the result of dynamic analysis, more detailed informations were obtained concerning the transfer characteristics of the portal vein, liver capillary and collaterals bed. These informations were useful not only in diagnosis but also in selecting the operation mode and examining surgical effect.