Study on RI Data Processing (10th Report)
A Non-linear Mathematical Model of Radioisotope Kinetics in Cardiovascular System

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In the present study an attempt was made to simulate the regional radioisotope (RI) dilution curve of the heart using an analog-digital simulator developed in our laboratory. The regional RI dilution curves were obtained with a scintillation camera. On this simulation study, non-linear chages cardiac volumes and valvular motions were taken into consideration. The cardiac volume curve was experimentally determined by the "area-length method" from cineangiocardiogram of normal subjects. The valvular actions were represented by switching function.

From the results of simulation study with this model, it was demonstrated that the serrate fluctuations of the radioactivity curves obtained from ventricles represented the changes of ventricular volumes.

For the simulation of aortic insufficiency, a feed back circuit was set between the outside and inside of the aortic valve. In this case, the curve obtained for the left ventricle showed an enhancement in amplitude of the fluctuation of the curve and a prolongation of disappearrance time in correspondence with the regurgitant ratio.

Ejection fraction was approximately calculated from the above-mentioned fluctuation. For a preliminary study, taking peak to bottom ratios of the serrate fluctuations, ejection fraction, end-diastolic volume and endsystolic volume were estimated in 6 cases. Satisfactory agreements were obtained between these hemodynamic values from RI data and those calculated from cineangiocardiogram.

From the present study, it was revealed that the pumping action of the heart was very much influential to configuration of the radiocardiogram, and that the simulation study was a useful method to take quantitative information from the radiocardiogrm.