Analog Simulation Analysis of Radiocardiogram in Heart Diseases

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Since 1964 the radiocardiogram examination has been one of the routine means of the evaluation of the patients with cardiac diseases or undetermined heart murmur in our clinic.

The purposes of the examination are (1) the screening of the patients with heart murmur of unknown etiology on the outpatient basis, (2) postoperative evaluation of the cardiac patients, and (3) cardiac evaluation of the poor risk patients for whom cardiac catheterization is not recommended.

Radiocardiograms were recorded by focusing a collimated scintillation counters over the precordium, the peripheral lung field, and over the peripheral arteries (frontal region), following intavenous injection of RIHSA or ^{131}I Hippuran.

79 cases of left-to-right shunts and normals were analysed using T½ (half time)/BT (build-up time) in the pulmonary curves. The left-to-right shunt group was clearly differentiated from the controls, and a remarkably good correlation was observed with a coefficient of correlation +0.92, giving a regression equation $X=29.88\ (Y=1.61)+47.66$ (X: shunt %, obtained by the Fick method, Y: T½/BT). The standard deviation of the differences between the values of the shunt-radio determined by the O_2 saturation method and by the T½/BT method was 7.79 per cent.

Recently an analog computer especially designed for simulation was made by Kuwahara et al. (Faculty of Engineering, Kyoto University).

The central cardiovascular hemodynamics can be shown as a simple model in which the right heart, the lung, the left heart and the body circulation are expressed as single mixing chambers placed in a line with the appropriate time delay between them. A left-to-right shunt was expressed as a single channel between the left heart chamber and the right heart chamber.

The characteristies of this analog computer model are as follows; (1) influences by a small chamber before the right heart chamber, (2) each heart chamber and the lung are regarded as single mixing chambers with the time delay between them (τp, τb), and (3) it is possible to presume the magnitude of the volume of the chambers by simulation. (The details of this analog computer is to be referred to the report of Kuwahara et al. read at this congress).

There was a good agreement on the ratios of cardiac output/the total blood volume obtained by observation and by computation in normal cases.

In 28 simulation of the cases of left-to right shunts, there was a good correlation between the ratio of the shunt flow to the pulmonary blood flow obtained by the Fick method and computation.

It should be emphasized that the analog simulation enabled evaluation for volume as well as flow.

In 14 computed cases of hypertensive heart disease an increase in %HV/TBV and %HVl/HVr and also a decreas in %SV/HVl were observed. In 4 cases of Cor pulmonale an increase in %HV/TBV and %HVr/HVl, and a decrease in %SV/HVr were noted. In a case of MS the result was similar in Cor pulmonare and in cases of MI the change was more like in hypertensive heart disease.