Studies of Radiocardiograph: Analysis of R-wave and the Estimation of Residual Blood Volume in Right Heart

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1. Scintillation counters (two of 2 × 3, and two of 2 × 2 inches NaI xtal), 4 fracks, 4 channels, tape recorder and 2 pen recorder were used for radiocardiograph (RCA) by external detection of 131I human serum albumin (Risa) injected intravenously.

2. From the geometrical difference of these counters to the heart, "pure R-wave" or right heart curve in radio cardiograph was derived by electrically subtracting the output of the counter placed on left side of the heart from the one on the middle of the heart.

3. After plotting the down slope of the right heart curve on semilogarithmic paper, removal rate of Risa from right heart was obtained, and the cardiac output per one stroke was also calculated from RCG.

   The residual blood volume in right heart was determined from these data.

4. By using 131I macroaggregated albumine, and by angiocardiography the "pure R-wave" was proved to be the right heart curve.

5. Right heart curves of 19 normal cases, 13 of patients with atrial or ventricular septal defect, 9 of mitral stenosis, and 15 of Fallot's tetralogy were studied. Prolonged down slopes of right heart curves were found in patients.

6. The values of residual blood volume in right heart, and ratio of cardiac output per stroke/residual blood volume in right heart were 77.4 ± 15.9 ml/m², 67.2 ± 20.0% in normal cases and 110.3 ± 51.5 ml/m², 32.3 ± 17.9% in patients with mitral stenosis.

7. The right heart wave was useful in programing of radio cardiography.

Radiography by Using Radioactive Oxygen and Carbon Dioxide
(The First Report)
(The Apparatus and the Measuring Method)

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Development of the external isotope method for measuring cardiac and pulmonary function contributed to cardiology and particularly to the study of abnormal cardiopulmonary physiology. But in Japan, it is not popularized to use the radioactive gases for the purpose of those studies.

This presentation was described about the apparatus and measuring method for the radioactive O₂ and CO₂ as results of studying in 45 patients (17 of heart disease).

We used oxygen-15, which had a half-life only two minutes and was produced continuously in the Institute of Physical and Chemical Research cyclotron by deuteron bombardment of nitrogen molecules. The gas was piped to the laboratory where it was diluted with air for immediate use as oxygen or converted to carbon dioxide before dilution.

The apparatus consisted of a rate-meter,
an electromagnetic oscillograph, a scintillation detector (5cm in diameter), a nitrogen-meter and a spirometer.

The patient was seated in a chair and inhaled the radioactive gas and held his breath for 10 seconds. The counting rate of radioactive gas was observed by the electromagnetic oscillograph. To examine the heart function the counting detector was placed on 2 F. B. laterally from the left sternal margin at the fourth intercostal space and when the examine was carried out to lung the detector was located on the upper and lower back on the scapular line on each side, totally 4 position were used.

The curves on the electromagnetic oscillograph were rearranged to a semilogarithmic graph after the correction for background. By using the technic we demonstrated graph obtained from normal healthy persons and that of the patient with severe degree of A.S.D.

We intend to continue the study about the patient with cardiac failure and poor respiratory function. The report of clinical data will be presented in other occasion.

Some Notes on the Determination of the Circulation Plasma Volume

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In the recent years it has attracted us strongly that the change of the circulating plasma volume after meal is the one of the most considerable factors producing Dumping syndrome.

In order to survey the circulating plasma volume, radioactive chromic chloride was used in our examination. 30 minutes before the test meal, 40μc of 51Cr in the form of chloride solution were injected intravenously and the blood enough for 1 ml of plasma was collected from the patient 3 times before and after test meal respectively to measure it’s radioactivity of the 51Cr. By these procedures we could find easily the disturbance of the circulating plasma volume provoked by the test meal and discuss the relationship between plasma volume changes and Dumping syndrome. The conclusion from the examination was contented.

Another discussion was argued to determine the actual circulating plasma volume by single collection of the plasma from the patient prepared with 51Cr injection. 40μc of the radioactive chromic chloride was injected intravenously, and 1 ml of the plasma were collected 10, 20 and 30 minutes after injection respectively. Now the circulating plasma volume can be determined correctly by the exploration from those 3 points. Then the authors found this correct value of the circulating plasma volume has such relationship with the value of explorated from the radioactivity of 20 minutes as shown by the next formula:-

\[ P_0 = \frac{1}{0.924} P_2 \]

\[ P_0 = \text{Exploration point by three kinds of plasma.} \]
\[ P_2 = \text{Radioactivity of 20 minutes after injection of 51CrCl.} \]

Analysis of variance showed also high significance of the exploration point by \( P_2 \).