

injected dose remained in the lungs. Half-time of radioactivity in the lungs was 300 minutes. Radioactivity in the liver was maximally ten per cent at 300 minutes after injection. Radioactivity in other organs was negligibly small. This tendency can be ascertained by autoradiography using ^{125}I MAA. Studies of concentration in blood and excretion in urine showed that the blood level was always below two per cent of the injected dose and that fifty per cent of the injected dose was excreted in the first twenty four hours in urine and ninety five per cent in forty eight hours.

104 human subjects injected 100–150 μC of ^{131}I -MAA i.v., have been scanned without any side effect since May '65 using Shimadzu SCC-30 with 36 holes focussing collimator. Photorecorder SCC-Y3, dot recorder and rate meter were driven simultaneously.

The ratio of the pulmonary blood flow obtained by analysis of cps curves of the rate-meter corresponded well to the ratio of oxygen consumption measured by differential bronchspirometry in nine patients of various chest diseases. The maximum difference between

the two procedures was ten per cent in one subject. In ten normal subjects, the ratio of the pulmonary blood flow in the right and the left lungs were 55:45 and 56:44 in the sitting and supine positions respectively. The ratios of the upper half of the lung and its lower counterpart were right 0.95: left 1.07 and right 1.60: left 1.88 in the sitting and supine positions respectively. In a case of dextrocardia the ratios were completely reverse in the right and the left lung.

A diagram of ratios of pulmonary blood flow in the right and left lungs and their scintigrams were shown in ten different chest diseases. Ratios of the pulmonary blood flow in bronchial asthma, emphysema, sinobronchitis, sarcoidosis and acquired heart diseases were within the range of normal value, but in some cases of lung cancer and bronchiectasis the ratios were extremely deviated from the normal range for the extent of the lesions. In tuberculosis, abscess, atelectasis, pneumonia and cysts, the ill side of the lung showed decreased pulmonary blood flow.

Clinical Significance of Lung Scanning with ^{131}I -MAA

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Scintiscanning of the lungs using ^{131}I -macroaggregated albumin (^{131}I -MAA) offers a new approach to the diagnosis of pulmonary infarcts. Since pulmonary blood flow to various regions of the lungs can be detected by the lung scan, this method is useful for diagnosis of chest diseases which are apt to obstruct regional pulmonary artery. Up to now, lung scans were performed on about 100 cases. In our opinion, the lung scan can give us some information about the difference between primary pulmonary cancer and secondary one. Of 16 cases of primary pulmonary cancer studied, 11 cases showed larger scintigraphical defect than radiographical abnormal area. This is probably due to a pressure to the pulmonary artery trunk from the metastatic hilar adenopathy. Accordingly, when it demonstrates larger scintigraphical defect than radiographical

abnormal area, there is no indication of a surgical operation. In 5 of 16 cases the scintigraphical defect was almost the same size of radiographical abnormal area. In these cases metastatic hilar adenopathy could not be demonstrated at operation time. Only one showed smaller scintigraphical defect than radiographical abnormal area. On the contrary, 7 of 9 cases of secondary pulmonary cancer showed smaller scintigraphical defect than radiographical abnormal area, and no cases larger scintigraphical defect than radiographical abnormal area. This may be possibly to be a help for the differential diagnosis between primary pulmonary cancer and secondary one.

By comparing radiographical findings with scintigraphical findings, pulmonary diseases can be diagnosed more precisely. Since this method can detect pulmonary blood flow

sharply, it is useful for a diagnosis of healing of the disease, provided that it is used as one indicator of pulmonary function for follow-up, and can be also useful for understanding of patho-physiological condition of cardiopulmonary diseases.

This method is safe, simple and rapid to perform and results are reproducible. Repeated scans may be done if need be. The application of this technique in evaluating other diseases of the chest is discussed.

Evaluation of Myocardial Blood Flow in Man with Radioactive Rubidium-86 by Means of Precordial Counting Method

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THEORETICAL CONSIDERATION

The present report is concerned with the application of the indicator fractionation technique, proposed by L. A. Sapiirstein in 1958, to the measurement of the myocardial blood flow in man. The principle of this method is that the blood flow measurement was made by determining the pattern of distribution of a single mass of injected indicator at a time when the indicator had been delivered to the organs by their arterial supply, but presumably had not yet left any of the organs by way of their venous drainage to a significant extent. At such time the distribution of the indicator can be taken to correspond to the distribution of the cardiac output, if the arterial blood supplying all organs is homogeneous. The radioactive indicator ^{42}KCl or $^{86}\text{RbCl}$ has such a character that its uptake by organs is proportional to their blood flow fraction of the cardiac output with only the exception of the uptake in the brain.

On these grounds, the myocardial blood flow (M.B.F.) can be described as the product of cardiac output and the fractional uptake of indicator in myocardium to the whole body uptake of indicator. While the cardiac output can be described as the total injected indicator divided by integrated, primary arterial concentration curve (A), that is Stewart-Hamilton's equation, and the product of the whole body extraction ratio (E)

for the indicator and the total injected indicator is equal to the whole body uptake of indicator, the myocardial blood flow can be described as follow:

$$\text{M. B. F.} = \frac{\text{Myocardial Uptake of Indicator}}{A \times E}$$

METHOD

After a single intravenous injection of Rb-86, we estimate precordial radioactivity obtaining simultaneously the samples of arterial blood from a brachial artery for a certain time after completion of the first circulation. The precordial activity is made up of an intravascular and an extravascular component. The intravascular component is determined by the intravenous injection of nondiffusible indicator like RIHSA, previously. The extravascular component may then be obtained by subtracting the intravascular component from the precordial activity; it is made up of myocardial activity and the activity in tissues other than myocardium. If the latter is neglected with adequate shielding of scintillation counter, the extravascular component may then be assumed to be equal to myocardial activity.

The whole body extraction ratio is calculated by using RIHSA which exclusively occupies intravascular segment of the body, and using Rb-86 which distributes either tissues and intravascular segments with their constant extraction ratio.

Now we calculate myocardial blood flow per unit mass of myocardium (M) as follow:

$$\text{M. B. F. / M.} = \frac{\text{Precordial Counting Rate due to Myocardial Activity}}{A \text{ (in Radiocardiograph)} \times E}$$