The New Observation of Regional Pulmonary Function Using ^{133}Xe and Scintillation Camera.—^{133}Xe Rebreathing Technique

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^{133}Xe-rebreathing technique using the scintillation camera was useful for determining regional pulmonary function in 80 patients with conditions such as large bulla, bronchial asthma or pulmonary cancer suffering dyspnea and cardiac disease. As the method, an anterior or posterior scintiphoto of the lungs was obtained at every 2 minutes from immediately after injection of ^{133}Xe-solution (1–4 mCi) intravenously. In ^{133}Xe-rebreathing technique, three phases of lung scintiphotos can be obtained. The first image of serial scintiphotos shows the perfusion phase (0–2 minutes exposure after injection of ^{133}Xe-solution) of the lung. The second image shows the ventilation phase (exposure time is 3–6 minutes after), and the third image shows the wash-out phase (3 minutes after washed out). In case 3 mCi of ^{133}Xe is administered, tissue absorption dose is calculated to be 21–31 millirads at the gonads and 572–593 millirads at the lungs. It was thought that this technique was more useful for determining regional pulmonary function than other other pulmonary function methods.

Studies on the Lung Scintigram by Means of Scinticamera

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The diagnostic value of lung scintigram by I-labeled MAA is great in determining the disturbance of blood flow. However, the dicision of size and localization of the disturbance has not perfectly been done.

Chest phantom experiments were carried out, in which lung simulated sponge imbibed with iodine solution (300 μCi of ^{131}I) was kept in the chest made of wax. Scintigrams of this normal lung were obtained from eight directions; anterior, posterior, two lateral and four oblique.

The same procedures excepting to cut off a lobe or a segment were compared with the normal in their scintigrams. At least one out of the eight directions was able to demonstrate the deficient segment anywhere in the lung, and it was able to determine the localization from eight scintigrams.

Clinical application was done to bronchial asthma and found the lesion being almost partially occured in the lung.

Effcct of Unilateral Hypoxia on Pulmonary Blood Flow Distribution

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In eight patients with various diseases involving lung cancer unilateral airway hypoxia was produced by having them breathe low oxygen gas (8% oxygen and 92% nitrogen)

administered for fifteen minutes via a carlens catheter.

The partition of pulmonary arterial blood flow between the two lungs was determined by radioisotope scanning following intravenous injection of ^{131}I-MAA both during bilateral air breathing and unilateral hypoxia.

The optical density of the radioscan is a nearly linear function of the amount of radioactivity at that locus. Therefore, the optical density of each lung field on the scan is proportional to the distribution of ^{131}I-MAA between the two lungs. The average density of each lung field was measured using a fluorodensitometer devised by us.

Unilateral hypoxia produced a decrease in pulmonary blood-flow to the hypoxic lung. It seems that a decreased pulmonary blood flow distribution results from pulmonary vasoconstriction.

We found one patient with bronchogenic carcionoma located at the left stembronchus in whom the scan indicated obstruction of pulmonary blood-flow to the left lung in spite of no abnormal finding on chest x-ray and pulmonary arteriogram. It was possible to make radical pneumonectomy in this case because of no vascular invasion and no metastasis of mediastinal lymph nodes.

It is probable that a decrease of pulmonary blood-flow distribution to the left lung in this case was caused by alveolo-vascular reflex. Therefore, the decreased density of the scan in bronchogenic carcinoma not indicate completely cancer invasion to the pulmonary artery.

Study on the Shift Ratio of Pulmonary Blood Flow in Right or Left Lateral Positions with Special Reference to the Radiation Effect on the Cases Having Pulmonary Carcinoma

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^{131}I-MAA pulmogram method has been used by us to estimate the relative amount of pulmonary blood flow to bilateral lungs.

In our former experiences on normal subjects, it was found that the mean right to left ratio in supine position was 53.3% to 46.7% by using this technique; and in lateral position another 10 or 20% flows excessively into the lowersided lung.

In cases with diffuse obstructive pulmonary disease, however, the shift ratio to the diseased lung in lateral position markedly decreased. This fact probably indicates that the combined use of ^{131}I-MAA pulmogram and lateral position might be very useful to know the reserve of the pulmonary capillary beds.

This time we are to report the change in the shift ratio of pulmonary blood flow in connection with pre- and post-irradiation against pulmonary carcinoma.

Seventeen patients with pulmonary carcinoma were examined. Six out of 17 were peripheral type and the others were hilar. In supine position, the disturbance of pulmonary blood supply to the diseased lung was much less in cases of peripheral type than in hilar type.

In lateral position, however, the change in the amount of shift to the diseased lung was quite variable and did not depend upon the localization of carcinoma. Even in the cases of hilar type, which showed decreased blood supply (less than 30%) to the diseased side in supine postion, more than a half of them showed an increase of another 10% or more in lateral position.

Ten out of the above-mentioned 17 cases were studied on the pulmonary blood supply right after the radiation therapy was through. These were composed of 7 cases of hilar type and 3 cases of peripheral type.

As for the cases of hilar type, in general, the pulmonary blood flow to the diseased lung seemed to increase in supine position after the radiotherapy. However, the change in the