Dynamic Cardio-Angio-Scintiphotography with Scintillation Camera

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Employing the gamma-ray scintillation camera, manufactured by Nuclear Chicago, serial cardiac scintiphotos with 5 seconds intervals were taken following rapid intravenous injection of 10 millicuries of $^{99m}TcO_4$ into the right antecubital vein.

In patients with normal heart, the superior caval vein was visualized within 5 seconds after injection. ^{99m}Tc was seen in the right atrium and ventricle, as well as in the pulmonary arteries between 5 and 10 seconds, thereafter radioactive material was distributed in the lung, left side of the heart and aorta.

Projecting areas of each atrium and ventricle on the scintiphotos were measured to estimate the sizes of intracardiac spaces. In patients with mitral valvular diseases, the areas of the left atrium were larger than those in normals.

Using a 35 mm. time lapse camera, scintiphotos with more rapid exposure intervals, e g. four pictures in a second, could be obtained. This allowed us to develope a device permitting to take serial cardiac scintiphotos corresponded to each phase of cardiac beat.

Two phase signals which synchronized with either mid-systole or mid-diastole of the heart were conducted from an electrocardiography by means of two delay circuits. Exposure intervals of 35 mm. time lapse camera were automatically adjusted by these signals. Applying this device, one can obtained serial cradiac scintiphotos in systole and diastole, alternatively.

This technique, to be called "Programing Radioisotope Cardiophotography", would permit visual monitoring of dynamic cardiac functions in health and diseases without any tedious and time-consuming manipulations.

Clinical Applications of Dynamic Studies with the Scintillation Camera

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The gamma-ray scintillation camera employed in this study was the PHO/GAMMA manufactured by Nuclear-Chicago. The test agent used was technetium 99m pertechnetate in doses of 10mCi. To visualize the superior vena cava, innominate, subclavian, axillary veins, thoratic aorta and common iliac arteries etc. a rapid injection of 10mCi of ^{99m}Tc was made into an appropriate antecubital vein and serial imaging exposures of 2-4 seconds are obtained with the Polaroid Camera or a programmed 35 mm camera. A superficial dorsal vein in the foot were used to obtain the radionuclide angiogramms of the inferior vena cava, deep and superficial femoral, and iliac veins.

We have been studying the values of the radionuclide angiogram of major vessels and trying to determine its merits relative to roentgen angiography.

1) A case of vena cava superior syndrom was shown. Chest roentgenograms depicted

a widened mediastinum and tumor histology was reported as lymphosarcoma. Gamma camera scintiphotos showed clearly the sit of obstruction, stagnant flow of the ^{99m}Tc bolus and collateral circulation. After 1500R irradiation, relief of obstruction was noted on follow-up scintiphotos as well as on scintiphotos. Scintiphotography was useful at the time of initial diagnosis as well as in follow-up evaluation of radiation therapy.

2) A patient of obstruction of the superior vena cava (Behçet's disease) was presented. This case was so serious that could not be performed angiogram. Complete obstruction, dilatation of subclavian vein and collateral circulation was confirmed by scintiphotos. Gamma Camera was very valuable for such serious patient.

3) A patient was suggested thoracic aneurysma by plain chest film and easily demonstrated by scintiphotos as sclerotic change of aorta. Aneurysma was sometimes differentiated from another disease by scintiphotos without roentgen aortogram.

4) Scintiphotos showed the site of narrowing of major vessels and simplify to roentgen angiography. Some cases of aortic arch syndrom and thrombosis of iliac arteries were also presented.

Application of Scintillation Camera to Diagnosis of Cardiovascular Diseases

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Value of Scintillation Camera as "radionuclide angiogram" is investigated. The camera employed in this study is the Pho/Gamma manufactured by Nuclear-Chicago. Technetium 99m pertechnetate 5~10 mc. is injected in right antecubital vein. The camera is operated immediately after injection. Serial image exposures of 0.5 or 1 second are obtained with the Polaroid camera and 35 mm Automatic time-lapse camera (1~2 photo/sec.).

In general, the figures of the right heart system could fairly clearly be visualized, but as to the left heart system the figures were not clear. In order to quantify the figure of scintiphoto of the heart, first, 1600 channel memory appartus was used. The figures accumulated 5 or 10 seconds after injection of ^{99m}Tc were obtained in several cases of cardiac diseases, but the resolution power was not enough for clinical application. Secnodly, the densitometry was used. On each scintiphoto the density of the central part in about 2 mm breadth was measured by a densitometer. In each case, the curves measured by a densitometer can be divided in 4 groups. (1) group represents the density of the right atrium and right ventricle, (2) group mainly pulmonary artery system, (3) group in addition to (1) and (2) both side pulmonary vascular system, and (4) group is situated between (1) and (2) and represents left atrium and ventricle. In our present knowledge, characteristic pattern of densitometry cannot be definitely demonstrated. But, in mitral insufficiency (4) group curve is increased in amplitude and breadth, and the peak of this curve is deviated to right. In a case of aortic stenoinsufficiency with mitral stenosis (1) group curve is increased in amplitude and breadth and (4) group curve increased in