C. Measurement B (in vivo)

Optimum Angle of Inclination of Collimator Holes in Tomo-Scintigraphy

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Tomographic rotating collimator systems consists of a collimator containing inclined holes rotating about the detector axis on the face of a gamma-camera. The object, containing the activity to be investigated, is rotated in synchrony with the collimator. In general, for a full rotation of bed and the collimator, the integrated image is a circle, There is one plane parallel to the crystal called section plane, in which all points are imaged as corresponding points in the crystal image plane. Its deapth h from the plane of the crystal image is given by $h=R \tan \theta$, where R and θ denote the radius of rotation of the bed and the angle of inclination of the collimator holes, respectively.

In order to find the optimum angle of inclination, we analysed the angular dependency of plane sensitivity, resolution area ($=\pi (FWHMc/2)^2$) in section plane, as well as the degree of depth discrimination defined by the distance (FWHMd/2) separating planes for which the displayed intensity of point source is one half that in the section plane. Here, FWHMc denote the full width of half maximum of point spread function in the section plane, and its angular dependency is given by $\alpha\ 1/\cos\theta$. FWHMd denote the full width of half maximum of depth spread function, and is given by $FWHMc/\tan\theta$. Plane sensitivity is theoretically shown to be proportional to $\cos\theta$. Performance criterion is defined by the ratio of plane sensitivity to resolution volume ($=FWHMd\cdot\pi\cdot(FWHMc/2)^2$), and its angular dependency is given by $\cos^3\theta \sin\theta$. By optimizing this performance criterion, we obtained 30° as the optimum angle of inclination of collimator holes.

Study on Methods of Scinti-Tomograms and Transmission Scinti-Tomograms

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The scinti-tomogram has been recently developed with a scintillation camera for separa-

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ting superimposed images from target ones. The study investigated experimental methods of the scinti-tomogram and its clinical applications. The transmission scinti-tomogram was also attempted.

The study used a Toshiba scintillation camera having an NaI crystal of 15-1/4 in. diameter. The spatial resolution and depth discrimination in the tomographic images were examined by using a bar-pattern phantom with Co-57 sources. The improved tomographic images were obtained by a rotational pin-hole collimator, producing the magnified images and the reduction of field of view. The choice of way of movement in scinti-tomography was discussed with regard to the rotational or rectilinear movement of the table. The transmission scinti-tomogram was examined by using a rotational collimator and the bar-pattern phantom with Co-57 sources. The potential uses of the transmission scinti-tomogram were considered.

Application of Pinhole Collimator to Scintigraphy of Large Organs

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The use of pinhole collimator has chiefly been confined to scintigraphy of the thyroid gland and seldom extended to that of the other organs. As a preliminary procedure, the characteristics of the 4.6mm caliber pinhole collimator in sensitivity, overall resolution, linearity, uniformity and detectability of space occupying lesion were studied. From the above, the clinical application of the pinhole collimator to scintigraphy of large organs were investigated in comparison with diverging and prallelhole collimators.

The results were as follows:

1) As it was lower in sensitivity than the other collimators, the pinhole collimator required four to five times as long as the others to obtain appropriate scintigraphy.

2) The sensitivity of the pinhole collimator was high on the center of the crystal and decreased gradually with approach toward periphery. But, the image was sufficient because of the gradual decrease of its uniformity.

3) If minified images were the same size, the pinhole collimator gave much better resolution than the diverging collimator.

4) The use of pinhole collimator gave satisfactory image up to a half adult size in a single view. Therefore, the pinhole collimator was useful for bone, lymphonode and tumor positive scintigraphy.

5) The magnification of the image using the pinhole collimator made space occupying lesion evident.

The investigation indicated that the pinhole collimator was made it possible to compensate for its low sensitivity by the administration of the short lived nuclides, while the wide scintigram with high resolution was obtained, and it was able to immediately magnify the region of interest if necessary, so it was not only useful for the scintigraphy of the thyroid gland but for the other organs.

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