

Invited Lecture 1**Single Photon Emission Tomography in Brain Tumor and Metastases**

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The single photon emission tomography, also called gammatomography (GT) has been found useful in brain. For several years GT was limited to systems providing only predetermined transverse tomographic sections. Recently a rotating gamma camera has become commercially available, providing transverse as well sagittal or coronal sections of a whole organ. The present study was undertaken to evaluate the reliability of such a GT system in brain tumor, and liver metastasis detection.

MATERIAL—METHOD

The GT system employed for this study comprised a standard GE Maxi Camera II and a ring supplied by General Electric which rotates the camera around a horizontal patient; the camera is connected to an Informatik Simis III 64 K computer system for data collection and processing. A bed was modified so that the patient's head can be placed at a suitable height within the camera rotation plane.

The physical characteristics, resolution (X, Y, Z), sensitivity, uniformity/linearity, statistical accuracy and quantitative accuracy of the system have been presented elsewhere. Briefly, the FWHMs of point sources either at the center or offset by up to 15 cm from the axis of rotation range from 15 to 16 mm in air or in a scattering medium. When a uniformly filled cylinder of activity containing cold 'cylindrical lesions' of various diameters is scanned, all lesions with a diameter greater than 10 mm are clearly visible. The slice thickness for a single transverse axial plane ranges from 17 to 19 mm depending on radial position. The sensitivity of the camera is of the order of 5 Kcps/mCi depending on the geometry of the source and in particular the amount of scattering and the energy window selected.

The clinical conditions under which the system was used were as follows. For a collection time of between 10–30 mn, it was possible to collect 3 to 5 Mcounts distributed in a set of 64 images at equal angular increments around the patient. These angular projections were stored as 64×64 matrices thus providing a maximum of up to 64 transverse views. An additional option being studied is the acquisition of 128×64 matrices permitting improved tomographic (transverse) resolution without degrading the slice thickness. After reconstruction by a conventional filtered backprojection (ramp filter used), the transverse axial tomograms were similarly stored as 64×64 matrices and the data

reorganized into coronal (frontal) and sagittal sections. When considering the clinical value of such tomograms, the data were visualized as sets of sections in three orientations: transverse axial, sagittal, and frontal planes. These sets of sections will be termed the three tomographic orientations.

Thirty four brain tumor patients and thirty two patients with suspected liver metastasis were studied; for the brain, GT scan and scintiscans were performed 90–150 minutes after the injection of 20 mCi of ^{99m}Tc gluconate or in a few cases 20 mCi of ^{99m}Tc pertechnetate. For the liver, GT scan and scintiscans were obtained after the injection of 5 mCi of ^{99m}Tc sulphur colloid.

RESULTS

—*Brain tumor*: In the 34 patients the presence of the tumor was confirmed by CT scan or by surgery. The GT was positive in 88 %, and scintiscan in 62 %, this number could be increased to 85 % if we sum the positive and doubtful scintiscans. If we consider separately the posterior fossa tumors (10 cases), the GT was positive in the ten and scintiscan in 3, if we sum again the positive and doubtful cases, the scintiscan was positive in 6 over 10.

—*Liver metastasis*. The metastases were surgically confirmed on 6 patients. The GT was positive on 5, echotomography in 3 as scintigraphy. The CT scan was done only in 3, and was positive in 2. For the 26 other patients suspected of metastasis, without any confirmation, who had a positive GT, echotomography was positive in 57 %; GT scan in 40 % and scintiscan in 31 %.

CONCLUSION

In brain tumor, the data presented confirm the previous results obtained. GT can be considered a reliable method, better than scintiscans but somewhat less accurate than CT. It can be very helpful in areas underequipped with CT scanners, in patients sensitive to iodine and possibly, in posterior fossa tumor. In liver metastasis, GT provides the contours of the organ and the homogeneity of the fixation. Such information apparently reveals and localizes liver metastases more clearly than echotomography and CT scans. Determining the exact role of GT, however, requires a thorough knowledge of the anatomical diagram of the sagittal and frontal GT sections due to the fact that one is working in true 3 dimensions.

GT at present seems to us to represent an extension of the possibilities of the gamma camera. Due to increased tumor/tissue contrast, interpreting GT images is easier and more reliable than images of conventional scans; and because of the possibility of obtaining a large number of three dimensional sections, localization will be accurate. Standard gamma cameras will probably be replaced in the next years by such systems which add the advantages of tomography to all the possibilities of the gamma camera for only a slight additional cost.