Invitation Lecture IV

Rotating Camera SPECT — Prospects for Clinical and Quantitative Studies

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Single photon emission computed tomography (SPECT) utilizing a rotating gamma camera tomograph offers a means to depict the true three-dimensional (3-D) distribution of radioactivity in the body. The advantages of 3-D imaging include improved image contrast, separation of structures that normally overlap in conventional scintigrams, and generally better visualization of normal and abnormal anatomic relationships. Such studies can also be potentially fully quantitative providing reliable spatial measurements such as organ volumes and accurate measurements of radioactivity within specific areas of the body. This paper will review these advantages and potentials in light of current data.

The immediate clinical benefits of SPECT derive from its improved image contrast and separation of structures and anatomy in three dimensions. For example, in liver imaging a number of anatomic structures are clearly visualized on SPECT studies that are usually not well seen in conventional images. These include the portal structures, caudate and quadrate lobes, and the gall bladder fossa. Several investigators have now showed improved image contrast in SPECT liver studies with resulting improved presentation of disease.

In other clinical applications, SPECT studies of the heart and the skeleton, particularly the facial bones and pelvis, illustrate the ability of this technique to separate anatomic structures into their true 3-D relationships. In the heart, the posterior and inferior wall are well seen in contrast to conventional scintigraphy. In SPECT studies of the facial skeleton it is quite easy to differentiate involvement of various bones of the head and face by tumor or other disease processes in a manner that is quite impossible with routine projection images. A number of examples of such applications will be given during the presentation.

Quantitative measurements of organ or lesion volume are both simple and accurate using rotating camera SPECT images and readily available computer technology. For example, routine determinations of liver/spleen volume or the mass of perfused myocardium are entirely feasible as routine studies now and probably would justify the use of the technique even if it had no other advantages at all.

Until recently, quantitative functional measurements using radiotracers have largely been obtained using PET studies. The advent of new single photon tracers such as 123-I iodoamphetamine now offer the possibility of obtaining quantitative functional measurements of such things as blood flow using SPECT techniques. There has been some strong disagreement over the feasibility of doing such measurements using rotating cameras. It has been suggested that such systems lack both sensitivity and adequate resolution to be useful for such measurements, particularly in the body. There is now abundant data to support the belief that cameras will provide adequate sensitivity and resolution for such measurements. This data will be reviewed in the context of currently feasible physiologic measurements. Rotating camera SPECT thus offers many possibilities for clinical diagnosis and non-invasive physiologic and metabolic measurements. This technology could be far more widely available and more versatile than other alternatives such as special purpose SPECT systems or PET devices. These advantages need to be pursued vigorously.

Invitation Lecture V

Computer Assisted Radionuclide Angiography to Detect and Confirm Reversible Ischemic Cerebral Dysfunction

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Computer assisted angiography (CARNA) with Tc-99m DTPA was employed in patients (pts) with transient ischemic attack (TIA) or prolonged reversible ischemic neurologic deficit (PRIND) to establish the sensitivity of CARNA in detecting and quantifying changes in hemispherical blood flow causing such dysfunction. This was achieved by computing a ratio (right to left hemisphere) from time activity curves (10 mCi, 100 images in 40 sec; normal (mean$\pm$2 SD): 1.00$\pm$ .12). Results of CARNA were additionally compared with findings in cranial radiographic angiography (RGA).

In TIA (106 pts), CARNA revealed a sensitivity of 75.0%. In PRIND (55 pts), it was 89.1%. Hemispherical perfusion deficit in TIA ($-.17\pm.11$) was significantly ($p<1.0$) smaller than in PRIND ($-.23\pm.11$). In TIA, interval from ictus to examination played a smaller role than expected (minimal sensitivity: 60%, 5–8 weeks after ictus). In PRIND, even smaller differences were found.

Sensitivity of RGA in TIA was 81.1%. Combined sensitivity (RAG and CARNA) was 93.1% ($p<.01$). Thus, CARNA may be employed both (A) as a screening procedure or even (b) as a complement to RGA in pts with reversible ischemic cerebral dysfunction. The latter employment (b) may be additionally used to quantify deficits in hemispherical blood flow in relation to morphological vascular alterations, described by RGA, and to the patients clinical presentation.