Early and delayed single photon emission CT in various cerebral diseases using N-isopropyl-p-(123I)diodoamphetamine

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Summary. Early and delayed single photon emission computed tomography (SPECT) using N-isopropyl-p-(123I)diodoamphetamine (IMP) was performed on 28 subjects (2 normal, 12 with cerebrovascular diseases and 14 with brain tumors) to evaluate the reversibility of the cerebral abnormality and cerebral viability. The results were compared with X-ray CT, ⁹⁹ᵐTc brain scintigraphy and rCBF by ¹³³Xe inhalation method. Three types of IMP kinetics were observed. Initial hypoactivity that changed over 4 to 6 hours approaching a normal pattern suggests a hypofunctional parenchyma without significant tissue damage: long-lasting abnormalities on IMP SPECT indicates cellular damage.

Key words: N-isopropyl-p-(123I)diodoamphetamine (IMP) – Single photon emission computed tomography – Kinetics – Cerebral diseases

Clinical material and methods

Early (30 min after injection) and delayed (4–6 h after injection) IMP SPECT was carried out on...
28 subjects: 2 normal, 12 with cerebrovascular diseases (two with transient ischemic attacks or reversible ischemic neurologic deficit, one with cerebral infarction, two who had ruptured aneurysms, one suffering from unruptured giant aneurysm, two with arteriovenous malformations, three with Moyamoya disease, and one after hypertensive intracerebral hemorrhage) and 14 with brain tumors (four benign gliomas, two malignant gliomas, one pituitary adenoma, one neurinoma, two meningiomas, two germinomas and two metastatic brain tumors).

The instrument used in this study was a circular-detector array emission computed tomography (SET-020, modified HEADTOME II, Shimazu, Japan). The data generated from the detectors were processed by a mini-computer system (ECLIPSE S-120, Japan Datageneral) and reconstructed by a filtered back projection method to obtain a single image composed of a matrix of 64 × 64 picture elements. Two rotating collimators, high sensitivity (HS) for dynamic study and high resolution (HR) for static study were adopted. The system sensitivity for $^{99m}$Tc was $30 \text{kcps}/\mu\text{Ci}/\text{ml}$ by HS and $7 \text{kcps}/\mu\text{Ci}/\text{ml}$ by HR collimator. Spatial resolution at the center of the field was $22 \text{mm}$ for HS and $11 \text{mm}$ for HR, respectively. One of the most successful features of the present system is the moving fin collimator. This collimator enables a circular array of crystals to be used for single photon tomography and has some favorable characteristics: high speed capability for dynamic studies, high spatial resolving power and convenient distribution of sensitivity with respect to swing angle [7, 17].

Before and after the study, each subject was given a few drops of potassium iodide solution (Lugol's solution) by mouth, in order to block the thyroid uptake of $^{123}$I or $^{124}$I. At least two tomographic images were obtained at 3 cm and 6.5 cm above the orbito-meatal plane. Additional images were obtained depending upon the clinical situations. The injected dose of IMP (Japan Mediphysics Laboratory) was 1–3 mCi and images were obtained at 30 min and 4–6 h after intravenous injection with the collection of 1,000 K counts per image. The patient's head was positioned by a special head holder with the orbito-meatal plane in a constant relationship to the circular detector array. For later studies, the patient was placed in the head holder exactly as before to obtain comparable slices. Mean radioactive values of the region of interest were compared with contralateral brain cortex or whole brain in each image.

A series of two pictures was taken during and after inhalation of Xenon-133 (15 mCi) for 1 minute. rCBF using inhaled Xe133 was calculated by the sequence of pictures method [6] and is expressed in our paper as mean ± SD. All patients had XCT and $^{133}$Xe-rCBF images near the time of their IMP studies and in the brain tumor group $^{99m}$TcO$_4^-$ brain scintigraphy was also investigated and compared to IMP SPECT images.

**Results**

**Normal control group**

In our 2 control patients, on the early SPECT (Fig. 1 left), the activity of IMP was greatest in the strips of cortex along the convexities of the frontal, temporal, parietal and occipital lobes and cerebellar hemi-