

Development of “super rapid dynamic SPECT,” and analysis of retention process of ^{99m}Tc -ECD in ischemic lesions: Comparative study with ^{133}Xe SPECT

Akio KOMATANI, Yukio SUGAI and Takaaki HOSOYA

Department of Radiology, Yamagata University School of Medicine

To analyze the retention process of technetium-99m ethyl cysteinate dimer (^{99m}Tc -ECD) in normal and ischemic lesions, we developed a super rapid dynamic SPECT system based on the CERASPECT (DSI, Inc., Waltham, MA, USA). The system made it possible to take a SPECT series every 2 seconds. Each SPECT series contains a maximum of 16 slices (6.6 mm slice interval) in a matrix size of 32×32 . The sensitivity of this system is 175 kcps/MBq/ml/cm slice thickness, and resolution is 12 mm FWHM at the center of a 20 cm ϕ water phantom.

Using the super rapid SPECT system, the kinetic behavior of the ^{99m}Tc -ECD during retention in normal and ischemic lesions was analyzed. Twenty patients with ischemic lesions that were clearly demonstrated by ^{133}Xe -rCBF (regional cerebral blood flow) SPECT but unclear on static ^{99m}Tc -ECD SPECT were examined. For the dynamic SPECT, 700 MBq of ^{99m}Tc -ECD was injected intravenously, and dynamic SPECT data were acquired every 2 seconds during a 90-second period. The serial dynamic SPECT and time-activity curves at some lesions with reduced rCBF and at the contralateral normal brain were analyzed. These dynamic SPECT data were compared with conventional static ^{99m}Tc -ECD SPECT and quantitative ^{133}Xe -rCBF SPECT.

All of mildly or moderately reduced rCBF lesions on the ^{133}Xe -rCBF SPECT were recognized as low activity regions only at the early phase (during about 2–20 sec or less), with the lesions then gradually vanishing. These lesions were not recognized on the conventional static SPECT taken after the dynamic study. The time-activity curve at the reduced rCBF lesion was lower than that of contralateral normal brain at the early phase, and overtook the activity in the normal region with a gradual increase.

The early phase images of ^{99m}Tc -ECD SPECT within 20 seconds by the super rapid dynamic SPECT were very useful to the same extent as the ^{133}Xe -rCBF SPECT for detecting mild or moderate ischemic lesions.

This study suggests that esterase activity, participating in the ECD retention mechanism, may be tolerable to mild or moderate ischemia. This tolerance may be the main cause of the nonlinear relationship between ECD accumulation and cerebral blood flow.

Key words: super rapid dynamic SPECT, kinetic behavior of ^{99m}Tc -ECD, ^{133}Xe SPECT