

Optimal brain ^{99m}Tc -ethyl cysteinate dimer SPECT imaging and analysis to detect misery perfusion on ^{15}O PET imaging in patients with chronic occlusive disease of unilateral major cerebral artery

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Abstract

Purpose: Misery perfusion is defined as marginally sufficient cerebral blood supply relative to cerebral metabolic demand. The aim of the present study was to determine the optimal brain ^{99m}Tc -ethyl cysteinate dimer (ECD) SPECT imaging and analysis to detect misery perfusion on ^{15}O PET imaging in patients with chronic occlusive disease of unilateral internal carotid or middle cerebral artery (MCA).

Methods: For 97 patients, cerebral blood flow, cerebral metabolic rate of oxygen, and oxygen extraction fraction were measured using ^{15}O PET; ^{99m}Tc -ECD SPECT was performed using dynamic scanning with a scan duration of 10 minutes each for 50 minutes after tracer administration. A region of interest was placed in the bilateral MCA territories and in the bilateral cerebellar hemispheres in all standardized images using a 3-dimensional stereotaxic region-of-interest template and affected-to-contralateral asymmetry ratio in the MCA territory (ARMCA) and contralateral-to-affected asymmetry ratio in the cerebellar hemisphere (ARcbl) were calculated.

Results: The ARMCA or ARcbl on ^{99m}Tc -ECD SPECT with a scan time of 20 to 30 minutes after tracer administration (ARMCA20–30 or ARcbl20–30) was correlated with ARMCA on PET cerebral blood flow ($r = 0.654$) or ARMCA on PET cerebral metabolic rate of oxygen ($r = 0.576$), respectively, more strongly than with other scan times. The area under the receiver operating characteristic curve for detecting abnormally elevated ARMCA on PET oxygen extraction fraction was significantly greater for ARcbl20–30/ ARMCA20–30 (0.947) than for ARMCA20–30 alone (0.780) (difference between areas, 0.167; $P = 0.0001$) on ^{99m}Tc -ECD SPECT.

Conclusions: Combination of asymmetries in the cerebellar and cerebral hemispheres on ^{99m}Tc -ECD SPECT in a scan time of 20 to 30 minutes after tracer administration optimally detects misery perfusion in unilateral internal carotid artery or MCA occlusive disease.