

Detection of misery perfusion in the cerebral hemisphere with chronic unilateral major cerebral artery steno-occlusive disease using crossed cerebellar hypoperfusion : comparison of brain SPECT and PET imaging

H. Saito¹, K. Ogasawara¹, K. Terasaki², M. Kobayashi¹, K. Yoshida¹ and A. Ogawa¹

¹Department of Neurosurgery, Iwate Medical University
19-1 Uchimaru, Morioka, Iwate 020-8505, Japan

²Cyclotron Research Center, Iwate Medical University
348-58 Tomegamori, Takizawa, Iwate 020-0173, Japan

Abstract

Purpose: In patients with unilateral internal carotid or middle cerebral artery (ICA or MCA) occlusive disease, the degree of crossed cerebellar hypoperfusion that is evident within a few months after the onset of stroke, may reflect cerebral metabolic rate of oxygen in the affected cerebral hemisphere relative to that in the contralateral cerebral hemisphere. The aim of the present study was to determine whether the ratio of blood flow asymmetry in the cerebellar hemisphere to blood flow asymmetry in the cerebral hemisphere on single-photon emission tomography (SPECT) correlates with oxygen extraction fraction (OEF) asymmetry in the cerebral hemisphere on positron emission tomography (PET) in patients with chronic unilateral ICA or MCA occlusive disease and whether this blood flow ratio on SPECT detects misery perfusion in the affected cerebral hemisphere in such patients.

Methods: Brain blood flow and OEF were assessed using ¹⁵O-PET and *N*-isopropyl-*p*-[¹²³I]-iodoamphetamine (¹²³I-IMP) SPECT, respectively, in 63 patients. All images were anatomically standardized using SPM2. A region of interest (ROI) was automatically placed in the bilateral MCA territories and in the bilateral cerebellar hemispheres using a three-dimensional stereotaxic ROI template, and affected-to-contralateral asymmetry in the MCA territory or contralateral-to-affected asymmetry in the cerebellar hemisphere was calculated. Sixty-three patients with reduced blood flow in the affected cerebral hemisphere on ¹²³I-IMP SPECT were enrolled in this study.

Results: A significant correlation was observed between MCA ROI asymmetry of PET-OEF and the ratio of cerebellar hemisphere asymmetry of blood flow to MCA ROI asymmetry of blood flow on SPECT ($r=0.459$; $P=0.0001$). The correlation coefficient was higher when reanalyzed in a subgroup of 43 patients

undergoing a PET study within 3 months after the last ischemic event ($r=0.541$, $P=0.0001$ for PET; $r=0.609$, $P<0.0001$ for SPECT). The blood flow ratio on brain perfusion SPECT in all patients provided 100% sensitivity and 58% specificity, with 43% positive- and 100% negative-predictive values for detecting abnormally elevated MCA ROI asymmetry of PET-OEF.

Conclusions: The ratio of blood flow asymmetry in the cerebellar hemisphere to blood flow asymmetry in the cerebral hemisphere on SPECT correlates with PET-OEF asymmetry in the cerebral hemisphere, and this blood flow ratio on SPECT detects misery perfusion in the affected cerebral hemisphere.