121

EFFECT OF ARTERIAL BLOOD DISPERSION ON THE MEASUREMENT OF CEREBRAL BLOOD FLOW USING PET AND O-15 WATER. M.Senda, S.Nishizawa, T.Shibata, Y.Yonekura, H.Saji, T.Mukai and K.Torizuka. Kyoto University School of Medicine, Kyoto and Fukui Medical College, Fukui.

In the regional cerebral blood flow (F) measurement using O-15 labeled water and positron emission tomography (PET) - autoradiographic (ARG) method, a wide discrepancy may occur between the time-activity curve in the brachial artery (Ca(t)) and the true input function to the regional brain (Ci(t)) due to the difference in blood dispersion along the arteries from the left ventricle to the respective peripheral site. A model was developed which described the difference of Ca(t) and Ci(t) with a time constant, T, following one shot i.v. injection of 20 mCi of O-15 water. A dynamic scan was performed for 128 sec with 16 sec/frame, and the regional F and T were estimated using diffusible tracer model. In a patient with the right internal carotid occlusion, the normally perfused areas showed approx. T=4 sec (less dispersion than at the brachial artery). In contrast, larger T values were observed in and around the infarcted area possibly because more dispersion occurred in the collateral vessels. This suggested that the PET-ARG method has a tendency to underestimate the regional flow in the diseased area and to overestimate in the normal area.

122


In order to investigate the validity of the H215O as a CBF tracer, brain/blood partition coefficient (PC) was measured accurately using dynamic PET (HEADTOME-III). The scan sequence consisted of 10 5-sec, 5 15-sec and 5 60-sec scans, total about 7-min. The input function, Ca(t), was obtained by withdrawing the artery blood continuously from radial artery using 0.5 mm diam, tube with 5 ml/min of withdrawal speed. The dispersion occurred in the tube was confirmed to be negligibly small. Using the single compartment tracer kinetic model, CBF(f), PC(p) and relative time difference between artery and tissue curve (at) were determined region by region. The obtained PC values were almost consistent with that obtained by another technique, i.e., the ratio of water contents in brain tissue to that in blood. The obtained values did not change over various fitting end time.

123


This paper aims to examine the hematocrit (Hct) effect on H215O-based CBF measurement in the C15O2 inhalation steady state study. Hct values were fixed to 1.0. Hct was measured from arterial blood and ranged from 33.0 to 50.0. CBF values were obtained from the temporal cortex (TMP) and the centrum semiovale (OVL). Correlation coefficient of these values with Hct were calculated. CBFs and CBFss were slightly and no correlated with Hct, respectively. CBFss/OLVss ratio, however, revealed a significant negative correlation, and its correlation coefficient was higher in OVL than TMP region. These observations were analyzed from the two aspects of Hct, i.e., partition coefficient and hemorheology. Both of these factors was found to partially contribute to phenomena of the present observations, but do not completely explain them. Further analyses are required.

124


The effect of the inaccuracy of the input function on CBF measured by the H215O autoradiographic method was investigated. In the H215O autoradiography, the measured input function included a larger dispersion than the true input function, as well as the absolute time axis having been already lost. Such dispersion, indispensable in a patient study, was found to produce large errors in calculating CBF, e.g. 5(10) sec of the dispersion time constant caused +15(33) and +10(20)% systematic overestimations for the 40- 60-sec accumulation time, respectively. An analytical correction employing an inverse Laplace transform was applied to clinical CBF studies, and the results were compared with the C15O2 steady-state inhalation CBF study. After the correction for the dispersion, the autoradiographic CBF values were reduced and almost consistent with the steady state values.