

Arterial fraction of cerebral blood volume in humans measured by positron emission tomography

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In quantitative functional neuroimaging with positron emission tomography (PET) and magnetic resonance imaging (MRI), cerebral blood volume (CBV) and its three components, arterial, capillary, and venous blood volumes are important factors. The arterial fraction for systemic circulation of the whole body has been reported to be 20–30%, but there is no report of this fraction in the brain. In the present study, we estimated the arterial fraction of CBV with PET in the living human brain. $C^{15}O$ and dynamic $H_2^{15}O$ PET studies were performed in each of seven healthy subjects to determine the CBV and arterial blood volume (V_a), respectively. A two-compartment model (influx: K_1 , efflux: k_2) that takes V_a into account was applied to describe the regional time-activity curve of dynamic $H_2^{15}O$ PET. K_1 , k_2 and V_a were calculated by a non-linear least squares fitting procedure. The V_a and CBV values were 0.011 ± 0.004 ml/ml and 0.031 ± 0.003 ml/ml (mean \pm SD), respectively, for cerebral cortices. The arterial fraction of CBV was 37%. Considering the limited first-pass extraction fraction of $H_2^{15}O$, the true arterial fraction of CBV is estimated to be about 30%. The estimated arterial fraction of CBV was quite similar to that of the systemic circulation, whereas it was greater than that (16%) widely used for the measurement of cerebral metabolic rate of oxygen (CMRO₂) using PET. The venous plus capillary fraction of CBV was 63–70% which is an important factor for the measurement of CMRO₂ with MRI.

Key words: cerebral blood volume, artery, vein, human, brain, PET