ORIGINAL ARTICLE

Annals of Nuclear Medicine Vol. 9, No. 1, 15–21, 1995

Regional cerebral blood flow, blood volume, oxygen extraction fraction, and oxygen utilization rate in normal volunteers measured by the autoradiographic technique and the single breath inhalation method

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By means of a high resolution PET scanner, the regional cerebral blood flow (rCBF), cerebral blood volume (rCBV), oxygen extraction fraction (rOEF), and metabolic rate of oxygen ($rCMRO_2$) for major cerebral gyri and deep brain structures were studied in eleven normal volunteers during an eye-covered and ear-unplugged resting condition. Regional CBF was measured by the autoradiographic method after intravenous administration of $H_2{}^{15}O$. Regional OEF and $rCMRO_2$ were measured by the single inhalation of $^{15}O_2$. With MR T_1-weighted images as an anatomical reference, thirteen major cerebral gyri, caudate nucleus, lentiform nucleus, thalamus, midbrain, pons, cerebellum and vermis were defined on the $CMRO_2$ images. Values were read by using circular regions of interest 16 mm in diameter. The posterior part of the cingulate gyri had the highest rCBF and $rCMRO_2$ values among brain structures, followed by the lentiform nucleus, the cerebellum, the caudate nucleus, and the thalamus. Parahippocampal gyri had the lowest rCBF and $rCMRO_2$ values among the cortical gyri. Regional OEF for the pontine nuclei (0.34 ± 0.04), the midbrain (0.35 ± 0.05), the parahippocampal gyri (0.35 ± 0.04 for the right and 0.37 ± 0.05 for the left), and the thalami (0.37 ± 0.05 for the right and 0.36 ± 0.04 for the left) were significantly lower than the mean OEF for the cerebral cortices (0.42 ± 0.04) ($p < 0.05$ or less). The global CBF and $CMRO_2$ were consistent with those obtained by the Kety-Schmidt method. Although several limitations to the quantification derived from an inadequate spacial resolution remain unsolved, the performance of the present PET scanner and the method for the quantification employed provide regional estimates of brain circulation and oxygen metabolism more acurately than the PET system and the steady state method previously used.

Key words: rCBF, rCBV, rOEF, $rCMRO_2$, PET