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Spectral analysis of ^{99m}Tc-HMPAO for estimating cerebral blood flow: a comparison with $H_2{}^{15}O$ PET

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Cerebral blood flow (CBF) can be quantified non-invasively using the brain perfusion index (BPI), which is determined using radionuclide angiographic data obtained through the use of technetium-99m hexamethylpropylene amine oxime (^{99m}Tc-HMPAO). The BPI is generally calculated using graphical analysis (GA). In this study, BPI was measured using spectral analysis (SA), and the usefulness of SA was compared with that of GA. Thirteen patients with various brain diseases and four healthy male volunteers were examined using radionuclide angiography with ^{99m}Tc-HMPAO. The BPI was measured for each subject using both SA and GA. In the four healthy volunteers, the BPI was examined at rest and after the intravenous administration of 1 g of acetazolamide (ACZ). An $H_2{}^{15}O$ PET examination was also performed in the 13 patients; the BPI^S and BPI^G values were compared with the CBF measurements obtained using $H_2{}^{15}O$ PET (CBF^{PET}). The BPI values obtained by SA (BPI^S) (x) and by GA (BPI^G) (y) were correlated ($y = 0.568x + 0.055$, $r = 0.901$) in the 13 patients and four healthy volunteers at rest, although the BPI^G values were underestimated by $36.1 \pm 7.5\%$ (mean $\pm$ SD) compared with the BPI^S values. The degree of underestimation tended to increase with increasing BPI^S values. The increase in the BPI^S was $32.1 \pm 8.0\%$ after the intravenous administration of ACZ, while the increase in BPI^G was only $8.1 \pm 2.8\%$. This discrepancy was considered to be the result of the BPI^G values being affected by the first-pass extraction fraction of the tracer. Although both BPI^S and BPI^G values were significantly correlated with the CBF^{PET} values, the correlation coefficient for BPI^S was higher than that for BPI^G (BPI^S: $r = 0.881$; BPI^G: $r = 0.832$). These results suggest that SA produces a more reliable BPI for quantifying CBF using ^{99m}Tc-HMPAO than the conventional method using GA. The SA method should be especially useful for activation studies involving pharmacological intervention and/or clinical cases with an increased CBF.

Key words: brain perfusion index, cerebral blood flow, spectral analysis, graphical analysis, single-photon emission tomography