Cerebral Blood Flow Threshold of Ischemic Penumbra and Infarct Core in Acute Ischemic Stroke: A Systematic Review

To the Editor:

In the above titled article,1 the authors reviewed 7 published studies that compared cerebral blood flow (CBF) measurements with a diagnostic gold standard (follow-up brain CT/MRI) and reported CBF thresholds for the differentiation between ischemic penumbra and infarct core. They found that the “reported CBF thresholds varied widely, from 14.1 to 35.0 and from 4.8 to 8.4 mL/100 g per minute for penumbra and infarct core, respectively.” They concluded that “the use of CBF thresholds . . . for imaging methods cannot be recommended without further evaluation.” Although the caution to await results of further evaluation is correct, there are several aspects of the article that need to be discussed:

1. In the 7 studies reviewed, CBF was measured with positron-emission tomography (PET) in 3 and with perfusion-weighted MRI (PWI) in 4. The analysis and results obtained with these 2 methodologies are very different. PET is quantitative and measures absolute (versus relative) CBF and is the de facto reference standard, whereas CBF measurement with PWI is relative.

2. Within PWI, the methods for calculating CBF can be divided into those that use deconvolution (references 22, 24, and 25 in the article) and those that do not (reference 14 in the article). The 2 analysis methods are significantly different from each other, and there are no published reports on the calibration between the 2 methods.

3. To convert the relative PWI CBF measurements (thresholds) into absolute values as given by PET, the authors scaled the relative values by a factor of 50 mL·min⁻¹·(100 g)⁻¹. This factor is the normal average value of CBF in younger adults (reference 26 in the article). In contrast, the mean age of subjects in the 4 PWI studies ranged from 64 to 71, and it is known that CBF does decline with age.2,3 Part of the observed variability in threshold can be a consequence of these age-related changes in CBF.

4. In more recent prospective studies involving admission CT perfusion and follow-up CT or MRI to define infarct size, receiver operating characteristic curve or logistic regression analysis has shown that CBF alone is not the optimal CT perfusion parameter to differentiate between ischemic penumbra and infarct core.4,5,6

5. Variability in thresholds in these studies can also be attributable to the type of analysis used. Voxel-based thresholds for infarction are known to be lower than thresholds derived from large region of interest analysis. Both analyses were included in this review.

Disclosures

None.
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