**Letter by Bos et al Regarding Article, “Intracranial Carotid Calcification on Cranial Computed Tomography: Visual Scoring Methods, Semiautomated Scores, and Volume Measurements in Patients With Stroke”**

To the Editor:

With great interest we read the recent article by Subedi et al., in which the performance of 2 visual scoring methods for intracranial carotid artery calcification (ICAC; ie, the original Woodcock score3 and a modified Woodcock score) is compared with volumetric ICAC measurements. The original Woodcock score characterizes calcification in the intracranial carotid artery as absent, mild, moderate, or severe. The modified Woodcock score as proposed by the authors involves the same 4-point classification, but it was applied to each slice of the computerized tomographic examination and then summed into a total calcification score.

The authors found a high correlation between the original Woodcock score and volumetric calcification measurements. Not surprisingly, this correlation improved for the modified score, which may be explained by the fact that more inspections reflect a more accurate approximation of the actual calcification volume. This directly underlines that, in contrast to the original score, the modified Woodcock score still involves slice-to-slice investigation of the total trajectory of the intracranial internal carotid artery. Although we expect that this could be less time consuming than slice-to-slice annotation of calcification, which is necessary for quantification, one should carefully balance the amount of information lost because of visual rating against time invested in the quantitative measurements.

At this moment, the semiautomated methods for ICAC quantification may be too complicated and time consuming for clinical use. However, the authors also argue that these methods, especially the method described by de Weert et al., are too time consuming and impractical for larger epidemiological studies. From our experience, there is typically less time pressure in epidemiological studies than in clinical practice, and there is more emphasis on the precision of measurements. Against this background, we would like to highlight that we quantified ICAC semiautomatically in a large, prospective population-based sample of >2500 middle-aged and elderly people and found that larger calcification volumes considerably increased the risk of stroke.4 This quantification strategy was relatively time consuming (≤8 minutes for a 1-mm thin slice protocol) but definitely not insuperable.

We think that future research on ICAC could benefit from the development of fully automated quantification tools, given several advantages of quantitative image analysis over qualitative ratings.5 Quantitative analyses are more objective and reproducible and provide continuous measures that are more sensitive to small changes. With respect to interscan reproducibility, an important consideration on the modified Woodcock score is the high dependency on the slice thickness (ie, the sum score is directly depending on the number of slices), whereas for quantitative/volumetric analyses, the slice thickness is taken into account in the calculations. There are numerous biomarkers for which qualitative scales have been replaced by automated quantification algorithms. Examples include the quantification of brain tissue or white-matter lesions as opposed to visual ratings to assess brain atrophy or white-matter lesions. Another more prominent example is the near-automatic quantification of coronary artery calcium, which has even found its way into clinical practice. We fully acknowledge that automated quantification of ICAC is not trivial because of its close proximity to the skull, which is one of the reasons that available near-automatic tools for coronary artery calcium are not sufficient. Yet given its importance in the etiology of stroke, we think that the development of such tools for ICAC deserves maximal effort.

Disclosures

None.

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