## Comment:
## The elusive search for markers of hematoma expansion

Hematoma expansion occurs in up to 40% of intracerebral hemorrhage (ICH) patients within 6 hours from the onset. Stopping the expansion is one aim of randomized clinical studies,[1] and an important clinical imperative. CT angiography (CTA) spot sign is a known marker, found in about 30% of patients. Ultraearly hematoma growth (uHG) (expressed as the ratio between hematoma volume [mL] and time [h] from onset to imaging acquisition) is also a useful marker of hematoma expansion.

The authors studied the association of uHG and the CTA spot sign in patients with ICH using a subpopulation of the Prospective Evaluation of Diabetic Ischemic Heart Disease by Computed Tomography (PREDICT) trial[2,3] and found that uHG >4.7 mL/h has higher sensitivity and better negative predictive value for hematoma expansion detection and for adverse clinical outcome than the CTA spot sign.

Their conclusions deserve further comment. First, while the sensitivity improves, the specificity decreases. More importantly, predictive value is a function of the pretest probability or prevalence. This is important because (1) the improvement in negative predictive value is rather modest and (2) variations in the pretest probability substantially change the predictive values. For instance, the reported positive predictive value (PPV) of uHG >4.7 mL/h is 49.5% for the pretest probability of 36%, yet the PPV goes down to 42% or up to 53% if the pretest probability changes to 30% and 40%, respectively. At the bedside, these predictive values are of little help to change management. We also wonder what the sensitivity and specificity would be if the CTA spot sign and the uHG were combined, given their independent effects.

The findings are nonetheless important to the extent that they help identify patients who are at higher risk and who may be candidates for clinical trials aimed at limiting hematoma expansion, thereby increasing trial recruitment. It would be premature, however, to recommend this marker as a clinical tool.

1.  Mayer SA, Brun NC, Begtrup K, et al. Efficacy and safety of recombinant activated factor VII for acute intracerebral hemorrhage. N Engl J Med 2008;358:2127–2137.
2.  Rodriguez-Luna D, Coscojuela P, Rubiera M, et al. Ultraearly hematoma growth in active intracerebral hemorrhage. Neurology 2016;87:xxx–xxx.
3.  Demchuk AM, Dowlatshahi D, Rodriguez-Luna D, et al. Prediction of haematoma growth and outcome in patients with intracerebral haemorrhage using the CT-angiography spot sign (PREDICT): a prospective observational study. Lancet Neurol 2012;11:307–314.

*Gustavo J. Rodriguez, MD*
*Alberto Maud, MD*
*Paisith Piriyawat, MD*
*Salvador Cruz-Flores, MD*

From the Neurology Department, Texas Tech University Health Sciences Center of El Paso.