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DOI: [10.1159/000321906](https://doi.org/10.1159/000321906)**Hyperdense Middle Cerebral Artery Sign and Stroke Outcomes after Intravenous Thrombolysis**

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We read with interest the study by Overbeek et al. [1] regarding the relationship between disappearing hyperdense middle cerebral artery sign (HMCAS) and striatocapsular infarcts on follow-up CT scans in acute ischemic stroke (AIS) patients treated with intravenous thrombolysis. This paper raises some important issues.

Although a significant number of AIS patients recover with optimal care and timely administered thrombolysis [2, 3], the

rates and the extent of recovery remain highly variable [4]. Considering the scarce and costly resources, early identification of reliable predictors for good outcomes is important for planning interventions and rehabilitation strategies. Although the National Institute of Health Stroke Scale score, age, gender and infarct volumes are established predictors of good outcomes [5–7], the disability score at day 7 might be a better predictor of long-term outcomes [8], as it excludes the neurological fluctuations during the first few days of AIS.

HMCAS is believed to represent the presence of a thrombus, associated with severe neurological deficits and poor clinical outcome [9]. However, its interpretation requires some important considerations. First, HMCAS on the initial scan can reliably predict the possible poor clinical outcome only in patients managed conservatively. In thrombolized patients, disappearance of HMCAS on the follow-up scan represents thrombus dissolution or fragmentation. We agree that some MCA occlusions may not recanalize completely, especially its deeper branches, and result in striatocapsular infarcts. However, such cases often show peripheral infarcts due to distal embolization of clot fragments

Fig. 1. Case 1 presented with acute left-sided weakness of 2 h duration. Unenhanced CT scan of the brain performed before thrombolysis showed HMCAS on the right side (a). HMCAS disappeared on the CT scan repeated on day 2 (b). Scattered peripheral hypodensities were noted in the right MCA territory (c). Although the HMCAS disappeared, the right MCA remained occluded on the CT angiography on day 2 (d). Case 2 presented with acute right-sided weakness of 90-min duration. Pretreatment unenhanced CT scan showed left HMCAS (e). Follow-up CT scan on day 2 showed persistence of left HMCAS (f) despite significant clinical improvement. Left cortical hypodensities represented the final infarcts (g). Although the left HMCAS persisted on the follow-up scan, CT angiography revealed complete recanalization of the left MCA (h).

(fig. 1, case 1). On the contrary, thrombolysis-induced complete arterial recanalization might be too late to prevent the tissue damage despite clearing the HMCAS. Second, HMCAS on the follow-up scan carries an important prognostic significance, raising the question of which is more relevant – its disappearance or persistence? While its disappearance may not represent complete recanalization (fig. 1, case 1), reliable assessments and outcome predictions are still possible from other imaging findings (final infarct size, intracranial hemorrhage and cerebral edema). Third, in patients who develop cerebral infarcts adjacent to the affected artery, the resultant hypodensity produces an enhanced gray-scale gradient, producing a ‘pseudo-hyperdense’ MCA. Finally, HMCAS on the follow-up scan should be interpreted in reference to the pretreatment CT scan. While HMCAS on the pretreatment scan represents an underlying thrombus, it may persist on the follow-up scan despite proven arterial recanalization (fig. 1, case 2). Although difficult to substantiate, a persistent HMCAS despite a patent artery on the post-thrombolysis scans could represent injury/inflammation of the arterial wall. Our tertiary care center runs an active thrombolysis program [10], and CT angiography is performed in most of the patients, both before thrombolysis as well as on day 2. In our experience, disappearance of HMCAS on the follow-up scan may not always result in good outcome; its persistence is mostly associated with poor outcome.

In conclusion, we propose that instead of looking for the disappearance of HMCAS, it might be wiser to look for its persistence on the follow-up scan, and other imaging findings should be taken into account for predicting long-term outcomes.

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