The Alphabet of Imaging in Acute Stroke
Does It Spell Improved Selection and Outcome?

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If we are to improve stroke treatment, we first need to assess the current state of affairs. Consider the next 100 patients with acute ischemic stroke in the United States, screened with noncontrast computerized tomography and treated with intravenous tissue-type plasminogen activator (IV tPA) within 3 to 4.5 hours, as recommended. On the average, only ≈5 of those individuals will actually get IV tPA; of those treated, only =1 of 5 will benefit. So, from our cohort of 100 patients, in the end, only 1/100 will get benefit from the only US Food and Drug Administration–approved acute stroke therapy. This is despite more than a decade of intense effort by stroke-related societies, pharmaceutical partners, hospital programs, and the tireless individual efforts of countless physicians, nurses, pharmacists, and emergency responders to “Get With the Guidelines” and expeditiously treat as many stroke victims as possible. Even in highly effective stroke centers where 10% to 20% IV tPA treatment rates are achieved, the math suggests that only 2% to 4% of that local population may benefit. As medical professionals, we need to recognize and find ways to get beyond these sobering empirical facts.

To improve stroke outcomes, we need to find ways to offer safe and more effective treatment to more patients in the acute phase. Part of the solution comes through use of more comprehensive imaging performed during acute stroke triage in the emergency department, ideally during the first hour. Certainly “time is brain,” and we need to move quickly to identify IV tPA candidates. A comprehensive computerized tomography or MRI protocol done properly does not impair time to decision and treatment with IV tPA. Cost analysis also supports the use of advanced treatment techniques, even when more upfront imaging is required.4,5

There is a solid and growing evidence base to support the use of advanced imaging to direct other acute treatment strategies, alone or in conjunction with IV tPA.6 Advanced imaging done in the first hour can help establish the diagnosis, identify treatable underlying causes of stroke, and direct judicious management based on individual anatomy and physiology rather than simply symptom duration and noncontrast computerized tomography findings. Comprehensive imaging refines the selection of candidates to ensure rational and safe treatment options are considered, including endovascular devices or thrombolytic agents directed to the acute clot, and medical or surgical treatments addressing proximal sources such as carotid plaque (Figure). The Golden Hour of stroke (the first hour after presentation) is not only the right time to find appropriate IV tPA candidates but it is also a golden opportunity to consider other treatment options to improve patient outcomes.

Sources of Funding
This work was supported by National Institutes of Health (NIH grant 5R01EB7021-4) (H. Rowley, principal investigator).

Disclosures
The author reports medical consulting income from GE Healthcare, Bracco, Eli Lilly, Lundbeck, and Gore, as well as clinical trial support from Guerbet.

References

Key Words: brain perfusion • CT • MRI • stroke • thrombolysis
Figure. A, Comprehensive imaging in acute stroke triage. This 71-year-old woman presented with fluctuating aphasia and right facial weakness, with a National Institutes of Health Stroke Scale=7, last seen normal 4.5 hours earlier. Computerized tomography was negative except for old lacunes, and tissue-type plasminogen activator was not given because of late time and rapidly resolving deficits. MRI done at 7 hours shows old bilateral lacunes in the basal ganglia on fluid-attenuated inversion recovery (FLAIR), but also subtle new left centrum semiovale ischemic changes on diffusion-weighted images (DWIs) and apparent diffusion coefficient maps (ADCs, arrows). A critical stenosis of the left middle cerebral artery (MCA) is seen on magnetic resonance angiography (MRA, arrow). Perfusion maps show relatively preserved cerebral blood flow and volumes (CBF, CBV), but marked prolongation of transit times (MTT and Tmax). This pattern indicates severe but partially compensated perfusion deficits extending well beyond the ischemic region on diffusion. The observed perfusion changes suggest a large ischemic penumbra, despite initial clinical improvement. The patient was observed overnight, but the next morning she was found globally aphasic and hemiplegic. An MR protocol was repeated, with only slight interval increase in the DWI lesion. There was a large persistent penumbra corresponding to her severe clinical deficits. B, She was referred for endovascular intervention, based on failure of medical therapy and favorable penumbral pattern. Angiography done at 23 hours after admission confirms a critical stenosis of the left M1 MCA segment (arrows). A Wingspan stent was placed (arrows depict end markers), with follow-up angiography showing excellent recanalization and reperfusion. The patient also recovered rapidly; now 2 years after intervention, she has normal language, only mild residual hemiparesis, lives at home, and walks a mile a day without assistance. (Case courtesy of Dr. David Niemann, University of Wisconsin, Madison WI.)
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Stroke. 2013;44:S53-S54
doi: 10.1161/STROKEAHA.113.001939

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