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MRI of Acute Stroke: What Went Wrong?

 K.-O. Lövblad and  V.M. Pereira



The news of the recently published trials about the efficacy of intra-arterial interventions for stroke lifted the spirits of all neuroradiologists and the vascular neurology community.¹⁻⁴ Finally, these trials proved our personal experience: Effective early reperfusion of proximal occlusions can save brain parenchyma and improve patient outcomes. Studies were focused on patient selection and fast-treatment workflow to perform interventions as early as possible. In most hospitals, the preferred imaging technique to select patients is CT with CTA and/or CT perfusion, based more on local logistics than on imaging quality or predefined standards. While we are no longer in the era of the early stroke trials, in which imaging with negative findings (ie, CT without hemorrhage) was the indicator for thrombolysis, we are still early in the use of advanced imaging in acute stroke interventions. It seems that just by identifying proximal occlusions, we have improved the selection of patients despite the limitations of CT to demonstrate early definitive lesions in acute stroke. While CT has made great strides in recent years, with perfusion, dual-energy, and other techniques improving and becoming a clear standard, MR imaging techniques seem to have “lost it,” at least, in acute stroke.

Despite the potential of MR imaging, such as the extreme sensitivity of diffusion techniques,^{5,6} its capacity to image the whole brain, and a whole armamentarium of techniques (FLAIR, SWI, MRA, perfusion, and so forth), this potential did not convince most centers to invest in or adapt their workflow to the use of MR imaging over CT. CT evaluation criteria and scores for acute stroke are undisputed. However, their assessment requires experience and can vary considerably among operators. MR imaging is vastly superior in delineating lesion extent, making the differential diagnosis of other conditions, measuring the clot length, and detecting potential “risky” lesions like microbleeds. DWI with or without FLAIR can still demonstrate an early ischemic lesion much better than CT.

So, what went wrong with MR imaging in stroke? In the era of the new-generation devices and early and effective reperfusion, has the clear identification of the stroke core lost its importance? One opinion is that use of MR imaging in an emergency setting disturbs the workflow, inhibiting effective treatment. Others might say that without a clear benefit from MR imaging, it is not worth the sacrifice in time to get better image quality. Recent studies have revolutionized the field of acute stroke treatment, but a significant proportion of patients have inadequate reperfusion.¹⁻⁴ How can we reduce or eliminate the inadequate reperfusion? Can MR imaging-based pa-

tient selection be a solution in addition to the improvement of health care systems, prehospital transportation, societal awareness, and hospital workflow improvements?


We think that MR imaging can add more information on patient selection for acute stroke and should be the ultimate goal for acute stroke triage imaging. DWI can define the early lesions, though reversible DWI lesions have been described also.^{7,8} A recent study described DWI-FLAIR mismatch as a potential parameter to consider in stroke selection, but its relevancy and validity are still to be evaluated and proved.⁹ SWI may be helpful in identifying potential lesions preventing hemorrhagic transformation and can precisely measure the clot length. MRA and MR perfusion have already demonstrated their benefits in recent trials (Extending the Time for Thrombolysis in Emergency Neurological Deficits–Intra-Arterial and Solitaire With the Intention For Thrombectomy as PRImary Endovascular Treatment [SWIFT PRIME]).² MR imaging allows better contrast with additional sequences such as SWI for bleeding, FLAIR for lesion identification, and arterial spin-labeling for collateral flow analysis. All these techniques would make MR imaging the ideal for acute imaging.

CT with all its advantages of being quick, easy to interpret, and widely available produces much less valuable information for acute stroke diagnosis than MR imaging at any stage of stroke onset. Except for imaging time, there is no major advantage of CT over MR imaging. This even extends to the determination of the collateral circulation. CT is a great contributor to radiation exposure during hospitalization, and given that these patients will require repeat imaging (at least ≥ 2 after the event), it is incomprehensible why MR imaging has not had a more important role in the acute phase.

Will this be enough to justify the investment in MR imaging for acute stroke? In addition to the practical aspects of patient throughput and imaging time, MR imaging adds complexity to the interpretation of images, especially in the differential diagnosis of stroke. While the literature tells us that hemorrhage can be demonstrated very early, very often in untrained hands, CT is preferred because the hematoma is clearly seen as a hyperdense mass which is easily detected and recognizable.¹⁰

In the end, there will always be a balance between imaging quality and treatment workflow. We cannot add too many sequences and have examinations that are long or slow down the process of getting the brain reperfused. However, with a careful selection of sequences, we should be able to better select patients for treatment, reducing reperfusion and hemorrhagic complications and increasing effectiveness.

The major step of creating evidence for mechanical thrombectomy in acute stroke is done. Now, we need to move forward and look for how can we make treatment for acute stroke even better and more cost-effective. Improving patient selection is an essential step in this direction. While MR imaging–derived techniques seem to be more sensitive and safer than CT in acute stroke, there is not a demonstrated benefit suggesting a change in stroke workflow in the centers using CT. We think this change needs to be reconsidered for the acute management of patients with cerebro-

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vascular diseases, given the potential tremendous benefit possible with MR imaging.

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