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In Japan, MR systems are very accessible. Compared to for instance Canada and Netherlands, Japan has about five times the number of MR units per capita. At Kyoto Prefectural University of Medicine, the department of radiology performs between 20 and 30 MR exams on stroke patients each month using Intera 1.5T.

Imaging in stroke patients

“The use of MR in stroke is already mainstream in our institute,” says Kei Yamada, MD, PhD, Kyoto Prefectural University of Medicine, Department of Radiology. “MRI is very important for us as it can help visualize infarcts in an early stage and also offers additional valuable imaging.”

However, time is a concern: a CT scan takes us about five minutes, but an MR scan takes us at least 20 minutes. “In an emergency situation, it’s a big difference between five minutes and 20 minutes,” says Dr. Yamada.

“When a stroke patient arrives, the neurologist will usually call us to see if MR is available, and if the system is occupied when we get the call, the patient is given a CT scan first, then an MR scan if it’s deemed necessary, for instance when no hemorrhage is seen on CT after tPA administration,” says Dr. Yamada.

“We don’t know which type of stroke a patient has when he or she comes in. If it’s ischemic stroke, we will see a DWI abnormality. If it’s hemorrhagic we will see dark signal on T2* imaging. Both sequences are included in the scan protocol, so that we know which type of stroke it is.”
**Acute embolic brain infarction at the left middle cerebral artery (MCA) territory**

This 77-year-old woman was hospitalized for angina pectoris (AP). She was found to have sudden mental status decline with left hemiparesis. She underwent MRI approximately 2 hours after the onset of this event. MRA revealed occlusion of the left MCA at the horizontal portion, with hemodynamic compromise at the same territory. There was, however, no apparent abnormality on DWI. After successful thrombolysis, she showed remarkable normalization of the mean transit time (MTT), and only has a small infarction involving the white matter of left temporal lobe (lower column).
**DWI helps to see early stroke**
In the acute phase, CT is useful to rule out the presence of hemorrhage. For stroke assessment, it’s easier to see infarcts with MR diffusion-weighted imaging (DWI) – especially small ones – at the earliest stage. “With CT, or on MR FLAIR imaging, it takes us at least three to four hours after the event before we actually see something in the images. But with DWI, we can catch infarct already about 40 minutes after it occurred.”

“DWI visualizes water molecule diffusion in the brain,” Dr. Yamada explains. “In healthy brain tissue, the intracellular water molecules are actively moving. But when the brain shuts down by deprivation of blood, then the cells have an energy failure, and the gelatinous content of the cells will stop moving, leading to diffusion restriction, and that increases the signal on diffusion weighted images. So, with DWI we see abnormally high intensity of infarcted tissue, and this hyperintensity can already be caught as quickly as 40 minutes after the clogging of the vessel.”

**MR exam offers more**
In the acute phase, imaging is performed for secondary prevention, to identify the culprit lesion (between heart and brain), and to help treatment decision-making. Dr. Yamada says, “I prefer MR more often than CT because I prefer to avoid the radiation exposure, and also to obtain the MR angiography and hemodynamic information.”

“MR angiography is used for visualization of vessels, to determine whether they are blocked or not,” says Dr. Yamada. “Angiography can be done using CT as well but in CT angiography contrast agents are used, which is not necessary with MR. MR’s ability to do hemodynamic imaging is another advantage in using MR for stroke.”

MR is also used to assess how much of the brain is well-perfused. “This information helps us to decide whether the patient needs treatment or not,” says Dr. Yamada. Studies have also shown that MR tractography may be useful for this decision [4].

In follow-up, MRI is used as often as it is available, and CT scans are sometimes intermixed, depending upon availability. MR is also used to perform plaque imaging which is a potential cause of stroke.

Dr. Yamada believes that the role of MR will grow for use in stroke patients when they first arrive to the ED. “I think that currently, on a global scale, a CT scan is used most often, but in the next 10 years or so, I think we may be seeing a shift toward MRI.”

**Small lacunar infarction of the internal capsule**
A 52-year-old woman with sudden onset of right hemiparesis underwent an MR exam at hyperacute stage. The T2-weighted image shows a small hyperintense lesion at the left cerebral hemisphere. From this alone, it may be difficult to discern whether the internal capsule or thalamus is involved. The diffusion weighted image with superimposed sensory (green) and motor (purple) tracts reveals the lesion directly involving the left motor fibers, a finding well correlated with the patient’s motor symptoms.

The fiber tracking method using thin slice diffusion tensor imaging (DTI) data set is clinically feasible1. Studies have shown the benefits of using tractography1. Parallel imaging technique is considered indispensable when performing DTI for tractography2.