

## **MRI in the Workup of Acute Stroke**

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**Learning objective:** The purpose of this presentation is to identify the critical alterations in physiology that may be identified with MRI and how this information may be used to triage and manage the acute ischemic stroke patient.

MRI provides a wealth of information on the state of a brain in a patient who is suffering from acute ischemic stroke. However, not all information is equal and there is a hierarchy of information that is important for the appropriate management of such patients. To understand the value of the MRI in the stroke patient, it is important to understand that stroke is a heterogeneous disease and that each stroke patient is different. Nearly 2/3 of all strokes are minor. These patients typically present with mild symptoms and the vast majority will recover completely or nearly completely whether or not they receive therapy. Approximately 1/3 of stroke patients suffer from major strokes. Typically these patients have severe neurological symptoms, account for the majority of in hospital cost, the vast majority of deaths, and are most likely to be discharged to a rehabilitation facility rather than to home. It is in this group of major stroke patients that MRI is most useful.

In patients who have a major stroke syndrome the critical questions are: 1. How large is the infarct core (irreversibly injured brain)? 2. How large is the 'penumbra' (brain that is threatened with further injury if treatment is not instituted)? Patients with major stroke syndromes typically have proximal artery occlusion of the intracranial circulation. These vessels include the distal internal carotid artery, the proximal middle cerebral artery and the basilar artery. The vast majority of patients have anterior circulation strokes and involve occlusions of the distal ICA and proximal MCA. The size of the core and the penumbra in anterior circulation strokes is dependent on the individual patients' collateral flow. In the absence of significant collateral flow, the core will be large and the penumbra small and treatment is generally not necessary. With good collaterals, the core is typically small, the penumbra is large and may be stable for many hours. It is this latter group of patients that aggressive therapy is warranted.

MR can identify each of these physiologic parameters. The site of occlusion can be identified with MRA. The best measurement for the core is the lesion identified on diffusion MRI. The penumbra can be estimated using various perfusion weighted imaging techniques. It is critical to understand that these parameters are not independent. Once the occlusion is identified, the relative size of the core and the penumbra are linked by the collateral circulation. If one is known, the other can be deduced. In a patient with a proximal ICA occlusion, if there is a small DWI abnormality, it can be deduced that the

penumbra is large. Conversely, in a patient with a similar occlusion, but with a large DWI abnormality, it can safely be assumed that the residual penumbra is relatively small. Preliminary work to date suggest that patients with proximal occlusion, it is the baseline DWI alone that can identify those patients who will most likely benefit from therapy aimed at removing the occlusion.

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