

Title: MR in the Emergency Room

Target Audience: Any radiologist who treats patients with neurologic emergencies and any research scientist who is developing fast pulse sequences to be used on critically ill and unstable patients

Objectives:

Audience members will learn strategies for imaging patients with acute neurologic emergencies in an efficient, high yield manner.

Audience members will learn the sequences necessary to image acute stroke patients in order to determine appropriate triage.

Audience members will learn the sequences necessary to determine extent of injury in patients with traumatic brain injury.

Audience members will understand the strategy for imaging pediatric patients with a quick brain protocol and when it can replace head CT.

Audience members will understand the strategy for imaging patients with traumatic injury to the spine.

Audience members will learn when a CT scan is sufficient for scanning patients with acute head and neck emergencies and when an MRI should be performed and what protocols to use.

Summary:

Acute stroke: Patients with acute stroke typically undergo NCCT scanning to exclude hemorrhage and hypodensity in more than 1/3rd of the MCA territory, factors that are contra-indications to thrombolytic therapy. They immediately receive a CTA to determine whether or not there is a proximal vessel cut-off. The patient is immediately transferred to the MR detachable table and wheeled to the MRI suite. In the MR suite, the patient receives a 2 minute DWI scan. If the patient is a candidate for thrombolysis, the DWI abnormality is measured with the ABC/2 parameter to determine whether the lesion is greater than 70 cc's, a contra-indication to thrombolytic therapy. If the patient is not a candidate for thrombolysis, additional sequences can be performed. These include (a) FLAIR to help determine stroke age – a stroke under 6 hours should have little to no FLAIR hyperintensity, (b) a 40 second GRE sequence or an SWI sequence to identify additional hemorrhage if the patient is considered at risk, (3) perfusion imaging to evaluate ischemic but viable tissue at risk of infarction, (4) and fat saturated T1 sequences to assess for dissection, (5) higher resolution coronal DWI sequence through the posterior fossa when a brainstem stroke is suspected but not identified on the routine axial DWI sequence, and (6) MRA sequences of the head and neck when a CTA has not been performed. Fast motion corrected sequences are used when a patient cannot cooperate with the exam.

Traumatic Brain Injury: It is difficult to image patients with TBI with MRI because they are usually very unstable and have multi-organ injuries. We typically obtain DWI, FLAIR and SWI sequences because they are useful for assessing the extent of diffuse axonal injury which may be important in patient management and prognosis.

Pediatric Neurologic Emergencies: It is important to minimize ionizing radiation, especially in pediatric patients. We use a Quick Brain protocol which consists of sagittal, axial and coronal HASTE sequences which can be performed rapidly without the need for sedation for the following indications: (1) Ventricular size check in patients with shunts, (2) Patients with mild traumatic brain injury under some circumstances, (3) Patients with a known intracranial lesion to assure stability in some circumstances.

Cervical (or thoracic or lumbar) Spine injury: Patients receive a CT of the spine first to assess for fractures. If the patient has a fracture or symptoms highly suggestive of ligamentous injury, the patient undergoes MR scanning. We typically image with sagittal T1 to assess the bone marrow and for subacute hemorrhage, sagittal T2 to assess the cord, sagittal STIR to assess the marrow, ligaments and soft tissues, and sagittal GRE to assess for hemorrhage.

Patients with headaches and a normal head CT: The vast majority of these patients do not need additional imaging. An algorithm for determining when a patient should undergo an MRI, MRA and/or MRV will be discussed.

Patients with dizziness or vertigo and a normal head CT: The vast majority of these patients do not need additional imaging. An algorithm for determining when a patient should undergo an MRI and/or MRA will be discussed.

Back pain: The vast majority of these patients do not need additional imaging. An algorithm for determining when a patient should undergo an MRI and a strategy for rapid imaging will be discussed.

Screening spine protocols: Images of the total spine are requested when the patient has nonlocalizing neurologic deficits. Rapid screening spine protocols for a number of particular scenarios will be presented. Some of the more common scenarios and sequences we use are:

- (1) Rule out cord compression – Sagittal T2's through the whole spine
- (2) Rule out osteomyelitis/epidural abscess – Sagittal STIR and gadolinium enhanced sagittal T1 sequences with fat saturation through the whole spine
- (3) Rule out demyelinating disease – Sagittal STIR and sagittal gadolinium enhanced T1 sequences through the cord
- (4) Rule out cord infarct – sagittal T2 and sagittal DWI through the cord

Head and Neck Imaging: High resolution CT imaging is frequently sufficient for imaging trauma and other head and neck emergencies. However, MRIs are obtained for particular

scenarios including: (1) optic nerve compression and intrinsic optic nerve abnormalities such as optic neuritis, (2) infections in which intracranial extension is suspected