Acute Neurologic Syndromes Beyond Stroke
The Role of Emergent MR Imaging

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KEYWORDS

• Diffusion • Nonischemic • Infection • Trauma • Toxic • Metabolic

KEY POINTS

- MR imaging is an important diagnostic tool in the assessment of injured or acutely ill patients in the emergency setting.
- MR imaging with diffusion-weighted imaging is important for the evaluation of nonischemic disorders.
- Various infectious, traumatic, toxic/metabolic, and other processes can show diffusion abnormalities, and should not be confused for acute ischemia.

INTRODUCTION

The use of MR imaging in the emergency setting for injured or acutely ill patients is crucial for the diagnosis, treatment, and follow-up for a variety of different disorders. Specifically, diffusion-weighted imaging (DWI) has played a critical role in patients who are suspected to have an acute stroke. DWI, however, can also be used to diagnose other nonischemic disorders that may be life threatening and may otherwise go undetected. These disorders can include infectious processes (cerebral abscesses, subdural/epidural empyemas, viral encephalitis), trauma (diffuse axonal injury [DAI]), and toxic/metabolic abnormalities (carbon monoxide [CO] poisoning, medication-induced toxicity, opioid toxicity), among other entities. These disorders may be erroneously attributed to changes related to ischemia or infarct, but a proper clinical history and findings on other MR sequences becomes essential for accurate diagnosis and treatment of patients in the emergency setting. This article describes some selected cases with diffusion abnormality that can be encountered in the emergency setting (**Table 1**).

INFECTIOUS PROCESSES
Cerebral Abscess

A cerebral abscess can be fatal if not diagnosed and treated in a timely fashion. The most common associated clinical symptoms are headaches (90%) and fevers (50%). These abscesses are typically secondary to sinusitis, mastoiditis, or otitis media or can be acquired by immunocompromised patients. Although the location is variable, these lesions are typically found in the frontal and temporal lobes at the gray-white junction, and may be associated with the presence of tortuous subcortical vessels that can serve as a nidus for this infection.[1,2] The 4 stages of cerebral abscess are early and late cerebritis followed by early and late capsule.

MR imaging typically shows a centrally T2/fluid-attenuated inversion recovery (FLAIR) hyperintense or heterogeneous-appearing lesion with surrounding edema and well-defined peripheral enhancement with the enhancing capsule being thin along the medial or white matter aspect of the lesion because of decreased vascularity in this location. They can also show peripheral T1

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Table 1
Selected cases with diffusion abnormality

Disorder	Clinical Context	Imaging Findings	Take-Home Points
Cerebral abscess	• Patients with sinusitis, mastoiditis, or immunocompromised • Headaches, fevers	• Peripherally enhancing, centrally necrotic cystic lesion • Central restricted diffusion	• Cystic lesion with peripheral enhancement and central restricted diffusion in the proper clinical context is typically abscess
Empyema	• Patients with sinusitis, mastoiditis, or thrombophlebitis	• Peripherally enhancing collection in the epidural or subdural space • Central restricted diffusion	• Empyema typically develops as an extension of an extracranial infection • Underlying meningitis or cerebritis is more typically seen with subdural empyema rather than epidural empyema
Herpes encephalitis	• HSV-1 in adults • HSV-2 in neonates • Headaches, fever, altered mentation, seizures	• Early: asymmetric cortical restricted diffusion in temporal lobes, insula, inferior frontal lobes, or cingulate gyri • Subacute: T2 hyperintensity, gyral swelling, enhancement, hemorrhage	• MR imaging abnormalities in the temporal lobes should raise concern for HSV encephalitis • Rapid empiric treatment with acyclovir is needed to minimize the high mortality of HSV encephalitis
DAI	• High-speed trauma with acceleration and sudden deceleration	• Multiple foci of restricted diffusion in the white matter • Multiple T2/FLAIR hyperintense lesions • Scattered hemorrhagic lesions on GRE or SWI	• Most (~80%) DAI lesions are nonhemorrhagic • Multiple DWI hyperintense lesions in high-speed trauma is DAI, and usually not infarct
CO poisoning	• Accidental or intentional exposure to CO	• Isolated restricted diffusion in the globus pallidus is the earliest imaging finding and is seen in the ultra-acute phase • Restricted diffusion can be seen in the cerebral white matter in all phases • Globus pallidus atrophy is seen in the chronic phase	• Imaging findings vary based on the time of imaging relative to the time of exposure to CO • Restricted diffusion in the globus pallidus is the first finding in the ultra-acute phase • Atrophy of gray matter structures in the chronic phase is commonly seen in patients with persistent neurologic symptoms