

The Global Reading Room: Imaging of Posttraumatic Headache

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A 19-year-old man presents to the emergency department with migraine headaches 7 days after a blow to the head during a martial arts competition. His neurologic examination is normal. The patient wishes to resume normal activities, including martial arts practice. As the radiologist, what imaging test, if any, do you recommend?

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For a patient with new or worsening headache in the setting of subacute trauma, brain imaging is reasonable based on the American College of Radiology appropriateness criteria. My preference would be to perform unenhanced brain MRI given the subacute nature of the trauma, assumed hemodynamic stability, young age, and desire to return to a contact sport. Compared with CT, MRI offers improved sensitivity for detection of small volume intracranial hemorrhage, axonal shear injuries, and contusive injuries and allows improved prediction of functional outcomes in traumatic brain injury (TBI) [1]. Though MRI findings may not change the patient's medical management, these findings may influence expectations on symptom resolution and impact return-to-play considerations. My opinion is in contradistinction to views on TBI outside of the imaging literature; the American Family Physicians Society and the Pediatric Emergency Care Applied Research Network both advocate for unenhanced head CT. Importantly, this opinion reflects the widespread availability of MRI at my institution, the use of accelerated imaging techniques to reduce MRI scan times, and desire to reduce ionizing radiation exposure in a young adult.

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Migraine is a recurrent unilateral headache of unknown cause that lasts more than 3 days. Trauma, as reported 1 week prior to presentation in this young man, is not a recognized precipitating factor. Thus, the prior head trauma may be a red herring. Because the patient has no history of migraines, the differential diagnosis includes diffuse axonal injury (DAI), subdural hemorrhage (SDH), congenital vascular anomaly, and a vestibular or cochlear migraine. The best single modality for evaluation is MRI (at least 1.5 T) using T1-weighted, T2-weighted, FLAIR, DWI, susceptibil-

ity-weighted, T2*-weighted gradient-recalled echo (GRE), and MRA sequences [2].

To diagnose DAI, susceptibility-weighted or GRE sequences are exquisitely sensitive to paramagnetic blood products and may show subcentimeter ovoid regions of susceptibility artifact representing hemorrhage at the gray-white matter junction in the cerebrum, corpus callosum, brainstem, or pons, surrounded by FLAIR hyperintensity. If the patient has SDH, given his subacute presentation, the collection may appear hyperintense on both T1- and T2-weighted images owing to extracellular methemoglobin. If a congenital vascular anomaly is present, MRA may depict a subtle or thrombosed berry aneurysm or arteriovenous malformation (AVM), though a bleeding AVM or ruptured aneurysm is unlikely. Finally, MRI has high sensitivity for a vestibulocochlear anomaly that may be causing the migraine.

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Posttraumatic headache (occurring within 7 days of head injury) is one of the most common complaints after mild TBI or sport-related concussion (SRC). In general, less than 1% of SRCs are associated with acute or subacute findings on unenhanced CT or conventional MRI, and most such findings do not alter clinical management [3]. Accordingly, consensus statements on SRC state that neuroimaging should be reserved for patients with high suspicion of intracranial hemorrhage or macrostructural injury. In such patients, CT is preferred over MRI given high sensitivity and specificity to detect hemorrhage. Regardless, concussion-related symptoms should resolve before the patient returns to sport to decrease risk of repeat concussion, prolonged recovery, or life-threatening second-impact syndrome. Increasing evidence from postmortem examinations and advanced neuroimaging studies shows that repetitive concussions or subconcussions in contact sports may lead to accumulation of microscopic structural and functional brain damage (e.g., connectivity changes, microhemorrhages, spectroscopic MRI alterations), with possible long-term devastating sequelae including chronic traumatic encephalopathy (CTE). However, currently no imaging markers can diagnose or predict CTE in vivo. While awaiting clinically useful biomarkers for management or risk stratification, counseling those at high risk of repetitive head trauma on potential major consequences seems most appropriate.

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I would recommend that the patient undergo brain MRI. The head blow may have caused brain parenchymal damage, which in turn caused the headache. Alternatively, the head blow may have been just an activating event for a primary underlying headache. In my experience, young patients with mild TBI, such as a minor head blow, commonly experience a full recovery within hours to a few days. As this patient had lasting migraine headaches for 7 days, special attention should be given on MRI for a potential underlying brain lesion. MRI is more sensitive than CT in detecting a range of possible causes, including TBI-related subarachnoid hemorrhage, contusion, and nonhemorrhagic axonal injury, as well as non-TBI-related brain lesions. Although I believe that brain MRI is appropriate for this patient, a negative conventional MRI is not sufficient to assure the patient's safety in resuming normal activities, especially martial arts practice. Rather, advanced imaging techniques including diffusion-tensor imaging, functional MRI, and arterial spin labeling may ultimately cast light on the cause of the patient's persistent headaches and guide further management.

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For acute TBI, unenhanced CT is the imaging test of choice. In this setting, several guidelines (e.g., the Canadian CT Head Rules) differentiate patients who should undergo CT from those who can safely bypass it. However, subacute and chronic TBI are best eval-

uated using MRI. For this patient with subacute trauma, additional clinical information should be obtained: Does he have a history of migraine, and if so, does his current headache feel like his previous headaches have felt? If not, the headache may well be related to the recent trauma, and MRI should be performed regardless of further considerations. If the answer is yes, then imaging is only indicated if justified by the severity of the initial symptoms after trauma. Symptoms that would justify MRI at my institution include witnessed loss of consciousness, definite amnesia, at least two episodes of emesis, or witnessed disorientation.

Early reconussions after TBI can have severe consequences, even in the absence of abnormalities on imaging. Therefore, consensus recommendations for athletes after head injury include staged, progressive return-to-play schedules [4]. If such recommendations are followed, unrestricted return to play can be allowed 1 week, at the earliest, after full resolution of symptoms.

References

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