When does an adult with headaches need central nervous system imaging?

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A 32-YEAR-OLD WOMAN presents to the clinic for evaluation of headaches, which she describes as pulsatile and throbbing, usually unilateral but involving different sides of the head at different times, and severe, causing her to miss work. They usually last between 12 and 24 hours and are associated with nausea but no vomiting and no changes in vision. They are worse around the time of her menses, have been occurring about twice a month for the past 6 months, and respond to ibuprofen. She thought they were caused by chronic seasonal allergies and sinusitis and has tried antihistamines and nasal irrigation without success. They are not affected by body position, they are not explosive, and they are not brought on by the Valsalva maneuver. She reports no other neurologic or systemic symptoms.

A detailed neurologic examination shows no deficits. However, the patient is concerned, as one of her friends was recently diagnosed with cancer. She requests imaging to "make sure there is no cancer." Would it be appropriate to order imaging at this time?

No, it would not. Patients who have primary headache disorders without red-flag symptoms should not undergo imaging of the central nervous system (CNS) as part of their initial evaluation.[1–4] (The list of potential red-flag symptoms is long but includes new onset after age 50, persistent neurologic changes, systemic symptoms or immunosuppression, sudden onset, progressive pain, positional nature, headaches precipitated by the Valsalva maneuver, and papilledema.)

CNS imaging may be appropriate for patients with features that increase the likelihood of structural diseases such as arteriovenous malformation, aneurysm, tumor, or subarachnoid hemorrhage. This patient, however, does not have worrisome signs or symptoms. Her symptoms are most consistent with migraine headache without aura. In patients with migraine headache without symptoms suggesting structural disease, CNS imaging is unwarranted and may be harmful.

Without red-flag symptoms, CNS imaging is unwarranted and may be harmful

DIAGNOSING MIGRAINE ACCURATELY

Diagnosing migraine headache can be a challenge, and up to half of all patients with migraine may be undiagnosed.[5] The proper diagnosis of headache type is critical to the initial evaluation. In diagnosing migraine, one can use the mnemonic POUND[4]:

- **P**ulsatile
- **O**ne-day duration (4–72 hours)
- **U**nilateral
- **N**ausea or vomiting
- **D**isabling.

If four or five of these features are present, the likelihood ratio that the patient has migraine headache is 24, making it overwhelmingly likely that is the correct diagnosis.[4] With three features the likelihood ratio is 3.5. If two or fewer features are present, migraine is much less likely, with a likelihood ratio of 0.41. Thus, patients with classic symptoms of migraine can

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be confidently and accurately diagnosed without the need for any imaging studies.

The patient in the vignette has all five POUND criteria. If we estimate her pretest probability of migraine headache at 50% (which is actually a conservative estimate—see **GUIDELINES AND CHOOSING WISELY**, below), then, utilizing Bayes' theorem, the likelihood ratio of 24 would result in a 95% probability that her headaches represent migraine.

GUIDELINES AND CHOOSING WISELY

High-quality reviews have found no benefit in performing imaging for primary headache disorders.[1–3] This is due, in large part, to the rarity of secondary headache disorders in the primary care setting. In fact, most patients—90% in one study[6]—presenting to their primary care physicians with headaches meet the diagnostic criteria for migraine.

Significant abnormalities on imaging in patients with migraine headaches are also very rare. In patients with migraine headaches who undergo imaging, the rate of worrisome abnormalities that could lead to a change in management (0.2%) is less than that in the general population at the time of autopsy (0.8%).[7]

When CNS imaging is needed, consider MRI instead of CT

As part of the Choosing Wisely campaign, the American College of Radiology and the American Headache Society recommend against imaging for patients at low risk with migraine headaches. Because of the potential for harm from radiation exposure, the American Headache Society also recommends against computed tomography (CT) for evaluating headaches when magnetic resonance imaging (MRI) is available, except in emergencies.

Lists of tests and treatments that physicians and patients should question and discuss together to make wise decisions are available at www.choosingwisely.org.

HARMS ASSOCIATED WITH CNS IMAGING

Medical tests can be associated with significant harm. Potential harms of head imaging include radiation exposure from CT and false-positive findings. These false-positives, such as the finding of lesions that eventually prove to be benign, may require further testing and cause significant anxiety to the patient.

The effective radiation dose from a CT scan of the head is 2.0 mSv, equivalent to 250 days of background radiation exposure or 100 chest radiographs. Radiation exposure has been linked to increased risk of fatal cancer, and the risks increase with subsequent radiation doses.[8]

Incidental findings are common on head imaging and often lead to additional medical procedures and workup, without improvements in patient well-being. While the harms of false-positive testing and the finding of benign lesions are difficult to quantify, it is clear that downstream costs can accumulate and that these results cause significant undue worry to the patient.

CLINICAL BOTTOM LINE

Patients with migraine headache who do not have red-flag signs or symptoms are unlikely to benefit from CNS imaging and may experience harm. The rate of abnormalities in this population is not significantly different from that in the general population. A thorough history and physical examination should be done to find the proper diagnosis and to uncover any red-flag symptoms. For migraine headaches that are worsened by identified triggers, those triggers should be addressed before further evaluation is performed. When imaging is needed, physicians should consider minimizing radiation risk by ordering MRI instead of CT.

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