

Imaging of Atraumatic Headache in the Emergency Department

Background

Headache is a common presenting complaint in emergency department (ED) patients (~3% of all ED visits).¹ Although the large majority of headaches are benign, occasionally headache is due to a potentially disabling or life-threatening disorder. In the ED, subarachnoid hemorrhage (SAH) occurs in up to 1% of presenting patients,² and may be present in 12% of patients with sudden severe headache (“thunderclap”), despite a normal neurological exam.³ SAH, in particular, may be misdiagnosed in up to 12% of ED cases, and up to 25% in other practice settings, leading to a substantially worse clinical outcome.^{4,5} Failure to obtain a noncontrast cranial CT is the most common diagnostic error.^{4,5}

The use of computed tomography (CT) and magnetic resonance imaging (MRI) to evaluate atraumatic headache in U.S. EDs has dramatically increased. Over 1998-2008, imaging increased from 12.5% to 31%, while the detection of intracranial pathology decreased from 10% to 3.5% (although the rate of missed serious disease is unknown and may have decreased with increased imaging use).⁶ A separate study reported a 60% increase in brain CT utilization from 2001-2007, without a decrease in the overall CT yield for intracranial hemorrhage (~3.0%).⁷ In order to mitigate potential adverse effects of CT imaging – such as radiation-associated malignancy, escalating costs, and ED length of stay – its use has been increasingly discouraged by external organizations. The Centers for Medicare & Medicaid Services (CMS) has developed an efficiency measure (Outpatient Performance Measure OP-15, Use of Brain Computed Tomography in the Emergency Department for Atraumatic Headache) to aggressively discourage imaging in atraumatic headache. This measure performs remarkably poorly in emergency department practice (16.7% accuracy),⁸ and it has been actively opposed as clinically inappropriate by the American College of Emergency Physicians (ACEP).⁹

Thus, ED physicians are squarely caught between *post hoc* perceived “overuse of diagnostic imaging”¹⁰ and the need to rule out a multitude of critical secondary headache disorders such as SAH, subdural hematoma (SDH), cerebral venous sinus thrombosis (CVST), stroke, dissection, intracranial infections, neoplasms, hydrocephalus, idiopathic intracranial hypertension, sphenoid sinusitis, and intracranial vasculitides. Regarding diagnosis of specific headache etiologies, CT is extremely sensitive (nearly 100%) and specific (100%) in identifying SAH when carried out within six hours of headache onset and interpreted by a qualified radiologist.¹¹ Unenhanced CT is insufficiently sensitive to definitively exclude some headache etiologies, such as CVST.¹²

Extant Guidelines

Emergency Medicine specialty guidance was published in 2008 (ACEP Clinical Policy).¹³ A SAH clinical decision rule has been proposed.¹⁴ However, the instrument is not validated prospectively and applies only to persons whose headache reached peak intensity within one hour. The 2013 Institute for Clinical Systems Improvement (ICSI) guidelines, although not aimed at emergency presentations, provide warning indicators that would suggest a need for neuroimaging.¹⁵ American Academy of Neurology/American Academy of Family Physicians guidelines are now outdated.¹⁶ The SCAN rule – Severe hypertension ($\geq 180/110$ mm Hg), Confusion, Anticoagulation, Nausea and vomiting – to reduce CT misdiagnosis of intracerebral haemorrhage was derived only in stroke patients.¹⁷ Prior neurosurgical procedures do confer a higher risk of intracranial pathology in patients with headache.¹⁸ Focal neurological findings are important to discover, as they increase the likelihood of positive neuroimaging, although their presence is not required for serious headache etiology.^{2,19} The 2014 ACR Appropriateness Criteria for Headache require navigating 16 different headache presentation variants and are of

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limited relevance to ED practice – i.e., determining which patients *may not* need imaging.²⁰

Risk Mitigation Strategies

In light of the multiple, sometimes conflicting administrative and professional guidelines and varying levels of evidence regarding management of adult patients presenting with atraumatic headache to the Emergency Department, the following strategies are suggested.

Potential *at-risk* groups with indications for emergent CT or other neuroimaging include:

- Patients presenting with headache and new abnormal findings in a neurologic examination (e.g., focal deficit, altered mental status, altered cognitive function, loss of consciousness, seizure, etc.)^{2,13,15,19,20}
- Patients presenting with new, sudden-onset severe headache or has a description of being the “worst ever”^{13-15,20}
- Headache of new type in HIV-positive patients or those with immunocompromised state^{13,20}

Other groups of concern for secondary headache for whom CT or other neuroimaging may be indicated:

- Headache of new onset after age 50^{13,15}
- Headache associated with prior neurosurgical intervention (e.g., VP shunt)¹⁸
- Patients with signs of elevated intracranial pressure (e.g., papilledema, worse when supine)²⁰
- Headache precipitated by exertion or sexual activity^{14,15,20}
- Patients with coagulopathy or taking anticoagulant medications¹⁷
- Headache of new onset in a pregnant patient²⁰
- Headache associated with significant hypertension on initial assessment ($\geq 180/110$ mm Hg)¹⁷
- A history of a progressively severe headaches¹⁵

Exclusion of other causes of secondary headache may require additional diagnostic or procedural modalities.

In patients without an established headache history, a low threshold for neurology consultation is suggested.

Prompt and reliable follow-up after evaluation is critical regardless of the diagnostic workup.

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