Indications for Imaging in Headache

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Abstract

Headache is a common malady among the general population and a routine indication for neuroimaging. Due to the ease and widespread availability of advanced neuroimaging, and in part due to patients' request, clinicians utilize imaging for the evaluation of patients with headache. However, the American College of Radiology (ACR) recommends against routine imaging for the most common headache presentations. The purpose of this article is to review basic radiological imaging algorithms for headache with brief discussion of common headache patterns.

Introduction

Headache is consistently among the top five most common reasons for emergency room visits.[1] Patients presenting with headache often request examining clinicians to obtain computed tomography (CT) and magnetic resonance imaging (MRI) to elucidate etiologies of headache. Yet, headaches can readily be categorized by their various clinical presentations and patterns. Headaches can also be characterized as primary, without an underlying etiology or secondary, as a result of another pathological condition. Frequently, radiological imaging to detect an underlying etiology of headache has a low yield. However, certain headache patterns and "red flags" have a higher probability of identifying underlying pathology and can help direct imaging decision patterns. This article briefly discusses common headache patterns such as migraines, tension headaches, and cluster headaches, along with direction to the clinician as to when neuroimaging is appropriate and will more likely demonstrate underlying pathology.

Discussion

Migraine is a common headache pattern which has been reported to affect up to approximately 15.3 percent of the population of the United States.[1] Females are affected at a higher rate with an incidence of 20.7 percent and males at a rate of approximately 9.7 percent.[1] Migraine headaches are described as moderate to severe in intensity and can present with or without aura. An aura is a fully reversible neurologic symptom such as a visual or sensory symptom which develops, recedes, and is followed by headache.[2] Chronic migraine is defined as a headache on more than 15 days per month for a period of three or more months. Migraines are commonly present in young adults around 20 years of age. Migraines are unilateral and pulsating with pain typically worsened by physical activity.[3] Features such as nausea and/or vomiting, photophobia, and phonophobia can also be associated.[2,3]

Tension headaches are typically less severe than migraines, although far more common with lifetime prevalence in the general population of up to 80 percent.[2] Tension headaches are described as headaches which are typically bilateral in location with tightening or band-like quality of mild to moderate intensity and can last from minutes to days.[3] Typically, physical activity does not aggravate the headache. Nausea and vomiting are also typically not associated.

In patients with classic new onset migraine or tension headache without neurological deficit, studies have demonstrated relative low positive (identifiable pathology) yield of imaging.[4,5,6] Holle et al demonstrated an 0.18 percent detection rate of significant intracranial abnormality when evaluating patients with typical migraine symptoms with normal neurological examination.[3] Additionally, imaging is usually not appropriate according to ACR criteria (Table 1).[7]

Cluster headache is the most common form of trigeminal autonomic cephalalgias (TACs).[3] However, TACs are rare as compared to migraine and tension headaches with a population prevalence of 0.1 percent.[2,8,9] Typical symptoms include severe unilateral pain in the orbital region and/or temple area lasting between 15 minutes to 3 hours. Patients typically have ipsilateral trigeminal autonomic symptoms such as conjunctival injection, tearing, nasal congestion, rhinorrhea, facial sweating, myosis, ptosis, and eyelid edema. Frequency can vary from one attack every other day to eight attacks per day.[3] The attacks can also be seasonal for some patients. Cluster headache is more common in males usually around 40 years of age.[3] Imaging of patients with cluster headache is recommended at least once to exclude secondary causes by ACR criteria using MRI Brain with and without contrast as the initial test.[7]

In patients with acute onset of "the worst headache of their life" or acute onset "thunderclap" headache, patients should be imaged with CT head without contrast to exclude subarachnoid hemorrhage as the etiology of headache (Figure 1).[7] In previous studies as many as 47 percent of patients presenting with thunderclap headache had a subarachnoid hemorrhage.[4,10,11,12]

For patients with new or progressively worsening headaches with certain "red flag" scenarios, imaging is more likely to be high yield and would be recommended. "Red flag" scenarios include headaches related to activity such as exertion, physical or sexual activity, recent trauma, new neurological deficit, cancer, immunocompromised state, or age greater than 50.[7] According to ACR criteria patients can be imaged with initial CT Head without contrast, MRI Brain with and without contrast, or MRI Brain without contrast.

In patients with a history of cancer or immunodeficiency such as HIV, a new onset headache should initiate radiological imaging as mentioned previously. MRI Brain with and without contrast would be the most sensitive evaluation in these scenarios (Figures 2 and 3). In a retrospective review of patients with brain tumors, headaches were a symptom in 48 percent of patients most similar to tension type headaches.[4] Additionally, a previous study demonstrated 82 percent positive yield in patients with headache and HIV most commonly with cryptococcal meningitis but also toxoplasmosis (Figure 3) and mass lesions.[4,13]

Patients 50 years and older with new-onset headache could indicate temporal or giant cell arteritis. This commonly involves large and medium arteries of the head predominantly in the external carotid artery branches. Patients can present with unilateral or bilateral severe headache

and tenderness overlying the temporal artery.[3] Patients can also have elevated erythrocyte sedimentation rate (ESR).[3] Early treatment with steroids can prevent visual loss or brainstem stroke.[4] Radiological findings are not specific for temporal arteritis and there is no current ACR criteria recommendation for temporal arteritis with regards to headache imaging. Imaging can demonstrate the extent of involvement (Figure 4) but clinical findings and temporal artery biopsy remain the standard for diagnosis of temporal arteritis.[3]

In patients presenting with new-onset headaches who also have papilledema on exam, imaging is suggested to determine the possible etiology of headache and evaluate for an etiology for possible increased intracranial pressure. The primary diagnosis to exclude with papilledema would be an intracranial mass lesion. Initial imaging with CT Head without contrast, MRI Brain without contrast, or MRI Brain with and without contrast are all considered reasonable initial imaging studies (ACR criteria) and are considered reasonable equivalent alternatives.[7]

For patients with chronic headaches with no change in pattern, and no neurological deficits, imaging is low yield and typically not indicated.[7] However, in patients presenting with chronic headaches who have new features or increasing frequency, it is reasonable to image the patient with a MRI Brain with and without contrast or MRI Brain without contrast.[7]

Other clinical scenarios in which neuroimaging may be helpful can include patients with symptoms suggestive of idiopathic intracranial hypertension (pseudotumor cerebri), intracranial hypotension, or unilateral Horner syndrome. Idiopathic intracranial hypertension is most frequently seen in young, obese females, who have papilledema and increased intracranial pressure on lumbar puncture. Neuroimaging can potentially demonstrate a partially empty sella appearance, distended optic nerve sheaths, flattening of the posterior sclera, and narrowing of the dural venous sinuses (Figure 5). Imaging is preferably recommended with MRI Brain and magnetic resonance venography (MRV) brain in patients with potential pseudotumor cerebri.[7] In patients with intracranial hypotension, imaging can demonstrate bilateral subdural collections, sagging of the brainstem, and low-lying cerebellar tonsils which is best demonstrated on MRI Brain (Figure 6). Sudden severe unilateral headache with radiation into the neck with Horner syndrome may indicate arterial dissection.[4] In a previous study, 68 percent of patients with dissection reported headache.[4,14] For patients with concern for arterial dissection, initial imaging with computed tomography angiography (CTA) head and neck would be recommended.

Conclusion

Although headaches are very common, imaging is frequently unremarkable. Many common headache patterns, such as migraine and tension headache, frequently have unremarkable imaging. However, certain clinical scenarios should initiate radiological imaging due to higher frequency of positive findings. Acute onset “worst headache of their life” or “thunderclap” headache should be worked up initially with CT Head without contrast to exclude subarachnoid hemorrhage. Additionally, patients with new onset or progressively worsening headaches with certain “red flags” such as headaches associated with exertion, recent trauma, new neurological deficit, cancer, immunocompromised state, or age greater than 50 should be considered for imaging using CT Head without contrast, MRI Brain without contrast, or MRI Brain with and without contrast which are considered reasonable equivalent alternatives by the ACR criteria.[7]

Figure Legend:

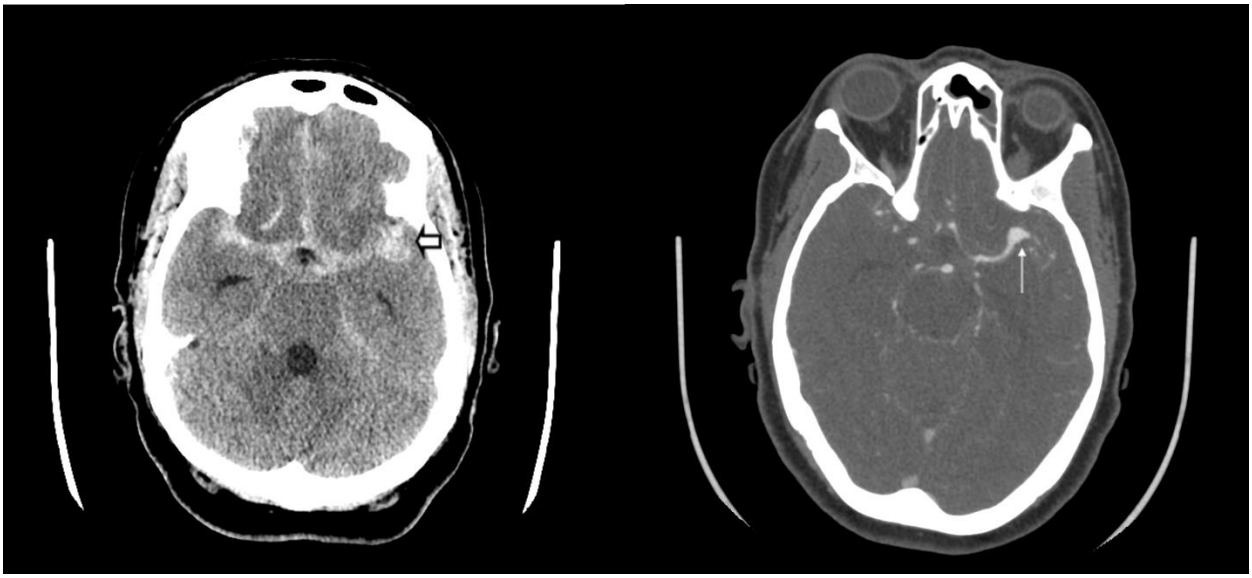

Figure 1: Initial Head CT without contrast demonstrates diffuse subarachnoid hemorrhage in the basilar cisterns with mild asymmetry in the left sylvian fissure (short arrow). A ruptured aneurysm is identified on a subsequent CTA head image at the left MCA bifurcation (long thin arrow).

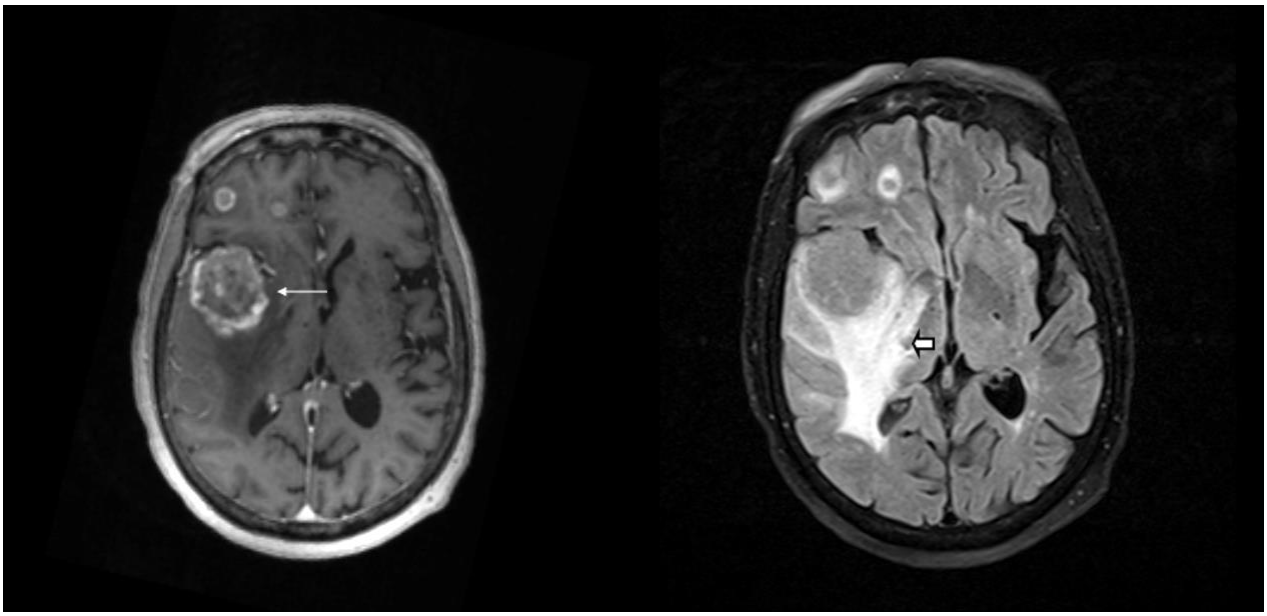

Figure 2: Axial T1 MPRAGE sequence with contrast demonstrates multiple enhancing intraparenchymal lesions in the right temporal and frontal lobes due to metastatic disease (largest lesion labeled by thin long arrow). A FLAIR axial image demonstrates adjacent vasogenic edema with mild mass effect most prominently along the right temporal lobe (short arrow).

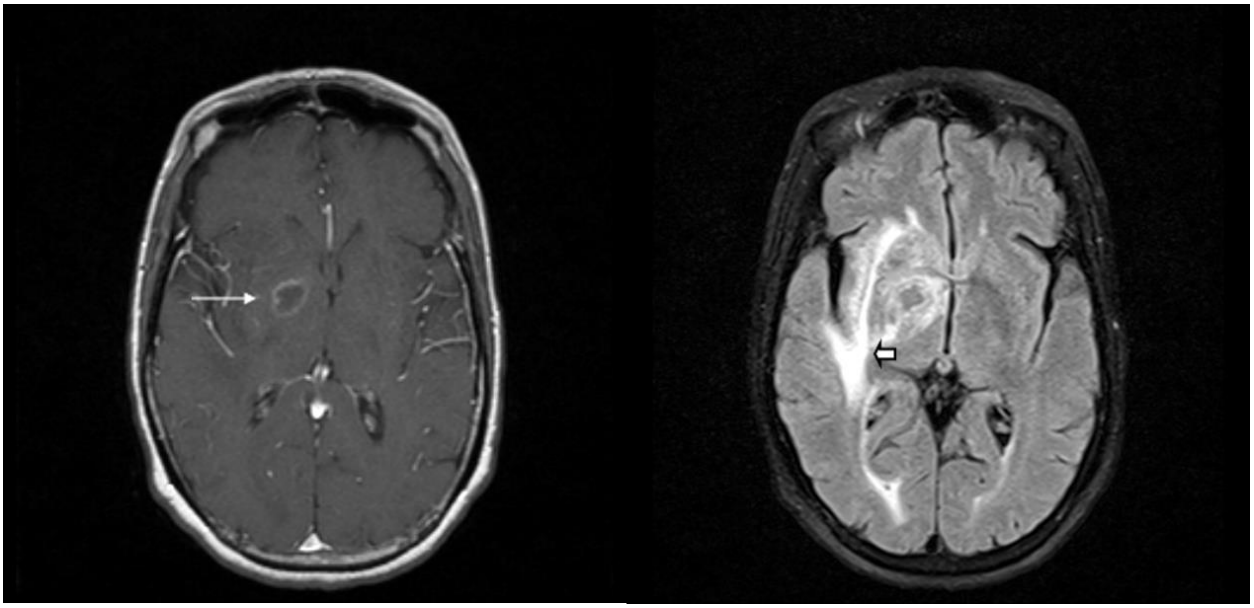

Figure 3: Axial postcontrast T1 image demonstrates a ring enhancing lesion present in the right basal ganglia (thin long arrow). On the FLAIR image there is adjacent high signal due to vasogenic edema (short arrow). Lesion was determined to be toxoplasmosis in a patient with HIV.

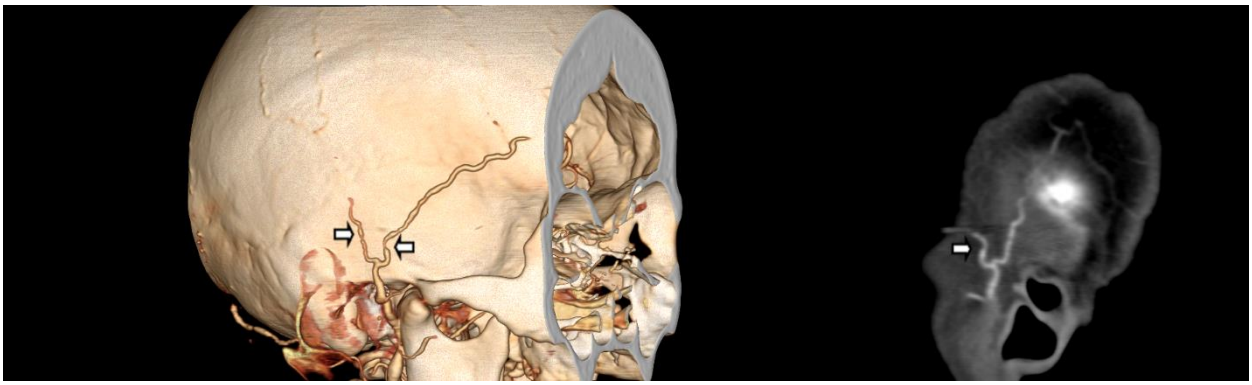

Figure 4: Volume rendered 3D image from a CTA of the head on the left demonstrates multiple areas of narrowing along the temporal artery in a patient with temporal arteritis (short arrows). A sagittal reconstructed Thin MPR image on the right also demonstrates areas of narrowing in the right temporal artery (short arrow).

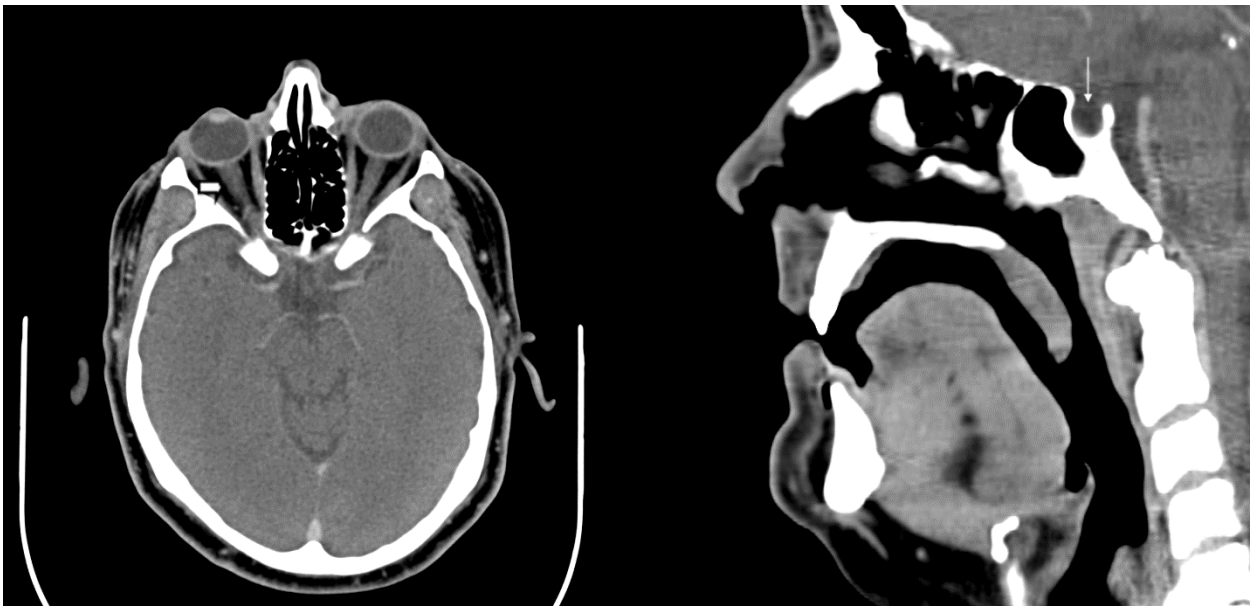

Figure 5: Axial CT neck soft tissue image with contrast at the level of the orbits demonstrates distension of the optic nerve sheath (short arrow). Sagittal CT soft tissue neck image demonstrates a partially empty sella (thin arrow) in the same patient with suspected idiopathic intracranial hypertension.

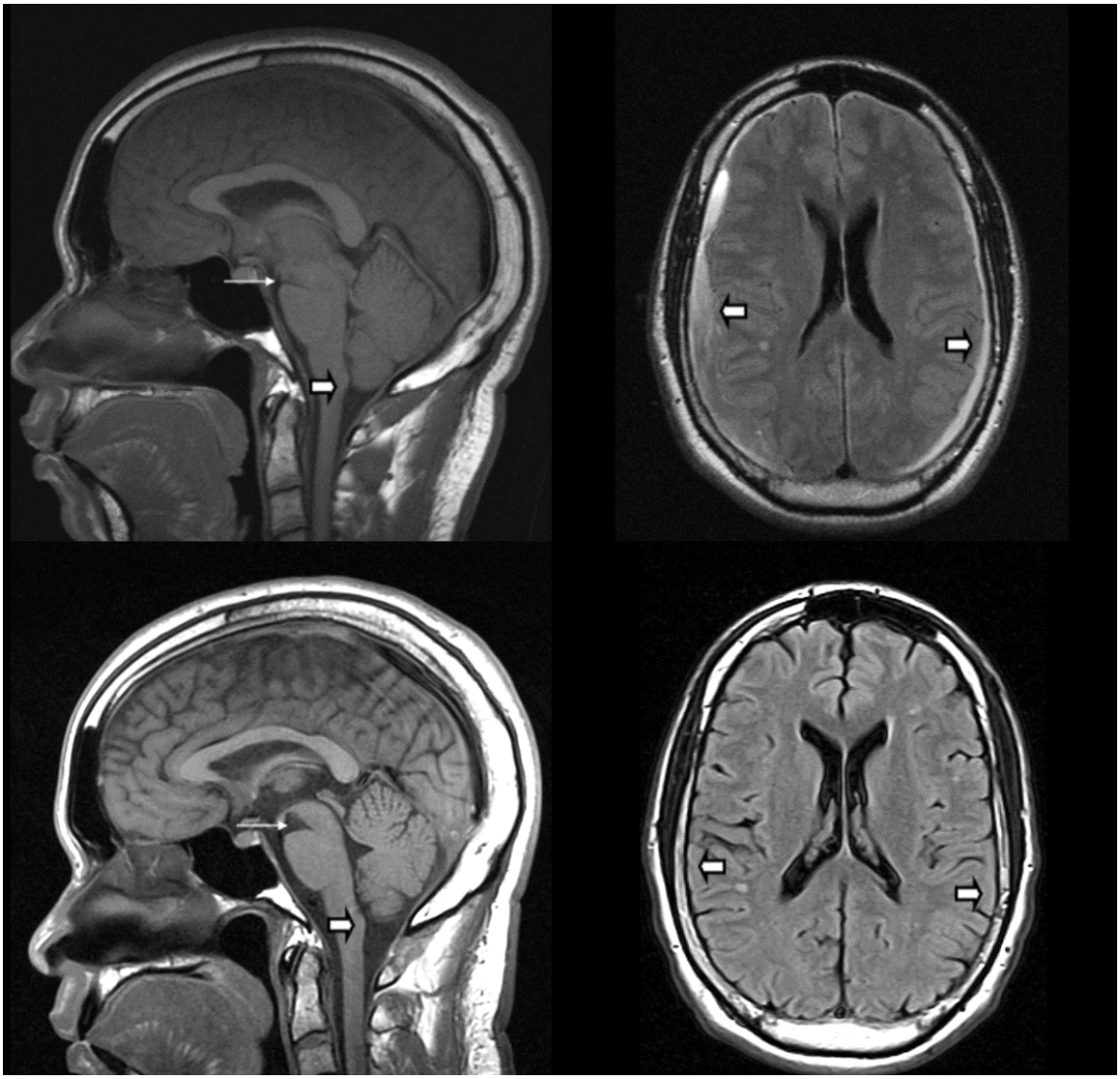

Figure 6: A patient with intracranial hypotension. Initial sagittal T1 MRI image (top left) demonstrates decrease in the midbrain-pontine angle (thin arrow) and mild crowding at the foramen magnum (short arrow). There are bilateral subdural collections overlying the cerebral convexities on an Axial FLAIR image (top right image - short arrows). Follow up MRI sagittal T1 image (bottom left) after resolution of symptoms demonstrates increase in the midbrain-pontine angle (thin arrow) and resolution of the crowding at the foramen magnum (short arrow). An Axial FLAIR image (bottom right) also demonstrates resolution of the bilateral subdural collections (short arrows).

Table 1: Imaging Algorithm Summary Table created by the authors based on ACR appropriateness criteria 2019

Clinical Scenario	Imaging Study
New or worsening headache with "Red Flag" scenario (includes headaches related to exertion, physical or sexual activity, recent trauma, new neurological deficit, cancer, immunocompromised state, or age greater than 50)	CT Head w/o, MRI Brain w/ and w/o, or MRI Brain w/o
Acute onset of "worst headache of life" or "Thunderclap" headache.	CT Head w/o
History of cancer or immunodeficiency such as HIV	MRI Brain w/ and w/o
New onset headache with papilledema	CT Head w/o, MRI Brain w/ and w/o, or MRI Brain w/o
Chronic headaches with no change in pattern and no neurological deficit	Not typically indicated
Chronic headaches with new features or increasing frequency	MRI Brain w/ and w/o or MRI Brain w/o
New headache of suspected trigeminal autonomic origin	MRI Brain w/ and w/o
New onset headache with classic migraine or tension type primary headache with normal neurologic exam	Not typically indicated

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Indications for Imaging in Headache – Post-Test

1. In patients with acute onset of "the worst headache of their life" which etiology should be excluded by imaging?
A. Brain tumor
B. Parenchymal Hematoma
C. Subarachnoid Hemorrhage
D. Sinusitis

2. Which clinical situation demonstrates relative low yield with neuroimaging?
A. HIV with new headache
B. Tension headache
C. Cancer history with new headache
D. "Thunderclap" headache

3. Tension headache lifetime prevalence in the general population is:
A. Below 5%
B. Near 25%
C. Up to 80%
D. Near 100%

4. In patients with chronic headaches and no change in pattern of headaches with no neurological deficit, imaging is high yield.
A. True
B. False

5. Prevalence of TACs (trigeminal autonomic cephalalgias), such as cluster headache, in the general population is:
A. More common than migraine headache
B. More common than tension headaches
C. Less common than tension headache but more common than migraine headache
D. Less common than migraine headache and tension headache

6. An aura is:
A. Commonly seen with tension headache
B. A fully reversible neurologic symptom such as a visual or sensory symptom
C. Seen with TACs
D. All of the above

7. Temporal or giant cell arteritis is typically seen in patients aged:
A. Greater than 50 years old
B. 20- 40 years old
C. 10- 20 years old
D. No age predilection

8. Migraines commonly present in patients aged:
A. 10-13 years old
B. 50-60 years old
C. Young adults around 20 years old
D. 70-90 years old

9. The primary diagnosis to exclude with papilledema would be:
A. Intracranial mass lesion
B. TAC
C. Intracranial hypotension
D. Tension headache

10. Temporal or giant cell arteritis:
A. Can be diagnosed by temporal artery biopsy
B. Can be treated early with steroids to prevent visual loss or stroke
C. Can cause elevated ESR
D. All of the above

EVALUATION:

1. What will you do differently as a result of this information?

_____
_____

2. How will you apply what you learned to your practice?

_____
_____

Please evaluate this article.

Circle one number using the following scale: 1= Strongly Agree to 5= Strongly Disagree

The article met the stated objectives: 1 2 3 4 5

The article was appropriate to my practice: 1 2 3 4 5

The topic was current and well presented: 1 2 3 4 5