

THE CONSULT

SPRING 2019

A PUBLICATION OF THE CDI QUALITY INSTITUTE

Appropriate Use of Imaging in Patients with Headache

BY STEVEN POLLEI, MD

INTRODUCTION

A headache is one of the most common clinical presentations for imaging and is extremely prevalent throughout the U.S. and developed countries. The vast majority of headache is benign and self-limited, but there are specific clinical scenarios that require more emergent imaging.

The majority of patients who present for imaging have chronic headaches, including migraine without change in pattern or primary headaches, which do not have an underlying medical condition. These are generally evaluated by detailed headache history and exclusion of secondary causes to diagnose primary headache. This clinical scenario without atypical symptoms or abnormal neurologic exam is unlikely to result in positive imaging findings.

Emergent imaging for headache is performed in patients that have atypical features, including change in frequency and severity or associated neurologic signs or symptoms.

If imaging is to be performed, MR scanning—if available and possible—is generally the most appropriate imaging study. There are limited numbers of headache where CT scanning is the primary diagnostic methodology, as those specific headaches are often associated with intracranial blood. These include headache after injury, headache after sexual activity and headache precipitated by exercise. Patients with chronic or subacute post-traumatic headache also should initially be evaluated by CT. MRI is preferred as it offers greater visualization of brain anatomy and does not use ionizing radiation. MRA and CTA are indicated in patients who have clinical symptoms that suggest a vascular cause. There are no indications for plain radiography for headache.

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STEVEN POLLEI, MD
CDI Medical Director & Neuroradiologist; Provider Led Entity Multidisciplinary Committee Member

This material summarizes key elements of Appropriate Use Criteria (AUC) developed by the CDI Quality Institute's Provider Led Entity (PLE). The CDI Quality Institute PLE has been qualified by the Centers for Medicare and Medicaid Services to develop AUC to guide the ordering of advanced imaging studies. The entire AUC library is available at myCDI.com/PLE.

This edition of *The Consult* summarizes criteria developed by Dr. Pollei and a panel of subject experts:

- Frederick Freitag, DO; Associate Professor of Neurology, Medical College of Wisconsin, WI
- Thomas Gilbert, MD, MPP; CDI Chief Clinical Officer and PLE Chair, CDI Quality Institute, MN
- Bruce Penner, RN; Rural Health Quality Consultant, MN
- Sonja Potrebic, MD, PhD; Co-assistant Chief of Neurology, Southern CA Permanente Medical Group; American Academy of Neurology Fellow, CA.

Clinical decision support (CDS) is not intended to replace clinician judgment, but rather to provide information to assist care team members in managing the complex and expanding volume of biomedical and person-specific data needed to make timely, informed, and higher-quality decisions based on current clinical science (National Academy of Medicine, 2017).

CLINICAL SCENARIOS

The strength of recommendations for imaging is indicated as follows:

- Green = indicated
- Yellow = indicated in specific scenarios
- Orange = probably not indicated, with limited exceptions
- Red = not indicated

Chronic headache (including migraine, tension, or medication overuse/rebound headaches) without a change in pattern, seizure, or neurological signs/symptoms:

●	MRI
●	CT
●	MR Angiography
●	CT Angiography
●	PET
●	SPECT

CLINICAL NOTES

- Primary headaches are headache disorders that are not due to another underlying medical condition (*SIGN* 2008).
- Clinicians should use a detailed headache history that includes duration of attacks and the exclusion of secondary causes as the principal means to diagnose primary headache (Beithon et al. [*ICSI*] 2013).
- Additional testing in patients without atypical symptoms or an abnormal neurologic examination is unlikely to be helpful (Beithon et al. [*ICSI*] 2013).
- Most primary headaches can be managed in primary care (*SIGN* 2008).
- When medication overuse is suspected, the patient should also be evaluated for the presence of psychiatric comorbidities and drug dependence (*TOP Clinical Practice Guideline* 2016).
- Patients with headache and red flag features for secondary headache should be referred to an appropriate specialist for further assessment (*NICE* 2015; *TOP Clinical Practice Guideline* 2016).

Headache with atypical features, an abrupt increase in severity/frequency, or an abrupt pattern change: OR Headache with neurologic signs/symptoms or seizures:

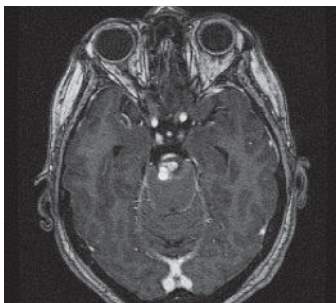
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head with IV contrast if the patient is unable to undergo MRI, if MRI is not available, or to characterize abnormalities detected on previous CT head without contrast
●	CT head without IV contrast if there is suspicion of hemorrhage, if patient is unable to undergo MRI, or if MRI is not available
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR angiography head, CT angiography head, MR venography head, or CT venography head if clinical or imaging suspicion of a vascular lesion
●	SPECT; PET

CLINICAL NOTES

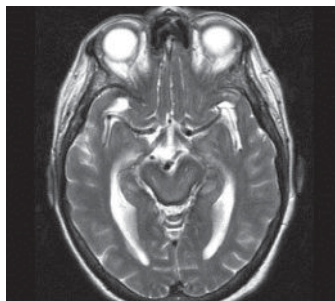
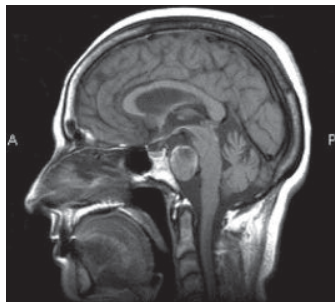
- A gradual increase in the frequency of migraine headaches over time is typical and does not need additional imaging (Mitsikostas et al. [*EHF*] 2016).
- Atypical features of migraine headaches may include hemimotor symptoms, hemisensory symptoms outlasting the headache episode (ictus), diplopia, and onset of new aura after the age of 40 (expert panel consensus opinion).
- Headaches that worsen with time may be due to a progressive intracranial lesion such as a tumor, subdural hematoma or hydrocephalus (Beithon et al. [*ICSI*] 2013).
- Further investigation is recommended for migraine patients with poor balance, visual symptoms affecting only one eye, or a decreased level of consciousness (*NICE* 2015).
- Neuroimaging in patients with headache and an abnormal neurological examination is significantly more likely to reveal an underlying cause (*SIGN* 2008).
- For patients with unusual aura symptoms, consider referral to a neurologist for diagnosis and possible investigation (*TOP Clinical Practice Guideline* 2016).

Sudden onset of severe headache (thunderclap headache):

●	CT head without IV contrast or CT head with and without IV contrast
●	CT angiography head and neck or MR angiography head and neck with and/or without IV contrast
●	MRI brain without IV contrast or MRI brain with and without IV contrast
●	MR venography head or CT venography head in patients with suspected venous sinus thrombosis
●	CT head with IV contrast, except to characterize abnormalities detected on previous CT head without IV contrast
●	MRI brain with IV contrast, except to characterize abnormalities seen on a previous MRI brain without IV contrast
●	SPECT; PET



Large aneurysm arising from basilar artery with leptomeningeal hemorrhage.



CLINICAL NOTES

- Thunderclap headache is defined as severe head pain of abrupt onset, reaching maximum intensity in < 5 minutes, but often < 1 minute (*ICHD-3* 2013; *NICE* 2015).
- New headache upon waking does not meet the classification of a thunderclap headache (expert panel consensus opinion).
- Differential diagnoses include subarachnoid hemorrhage (SAH) or other intracranial bleeding, brain infarction, reversible cerebral vasoconstriction syndrome (RCVS), cerebral venous thrombus, cervical arterial dissection, meningitis and/or encephalitis, hypertensive encephalopathy and eclampsia, pituitary necrosis, and temporal arteritis (Moisset et al. 2016).
- Other causes can also produce the same clinical presentation: cerebrospinal fluid (CSF) hypotension, angina pectoris or intra-ventricular tumor (Moisset et al. 2016).
- Patients with a first presentation of a thunderclap headache should be referred immediately for same-day specialist assessment; thunderclap headache is a medical emergency as it may be caused by subarachnoid hemorrhage (*SIGN* 2008).
- Sensitivity of CT for subarachnoid hemorrhage is 98% at 12 hours, dropping to 93% by 24 hours (*SIGN* 2008).
- Lumbar puncture may no longer be indicated to exclude a subarachnoid hemorrhage following negative CT conducted within six hours of onset (Dubosh et al. 2016; expert panel consensus opinion).
- If the patient is to undergo lumbar puncture to exclude subarachnoid hemorrhage, neuroimaging should be performed first (*SIGN* 2008).
- If MRI is obtained to evaluate a thunderclap headache, it should include fluid-attenuated inversion recovery (FLAIR), gradient recalled T2* and/or susceptibility-weighted imaging (SWI) sequences (expert panel consensus opinion).

New headache with systemic symptoms, suspected encephalitis, or suspected meningitis:

●	CT head without IV contrast
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR angiography head, CT angiography head, MR venography head, or CT venography head to evaluate for suspected vascular involvement or vascular complications
●	SPECT; PET

CLINICAL NOTES

- Headache is typically associated with neck stiffness, nausea, fever and changes in mental state and/or other neurological symptoms and/or signs (*ICHD-3* 2013).
- Patients who present with headache and features suggestive of central nervous system (CNS) infection should be referred immediately for same-day specialist appointment (*SIGN* 2008).

New headache or change in headaches in a cancer/immunocompromised patient:

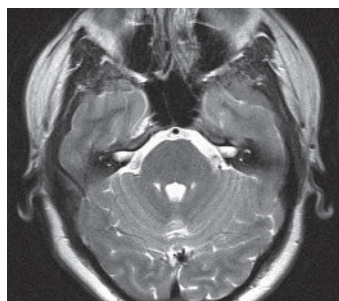
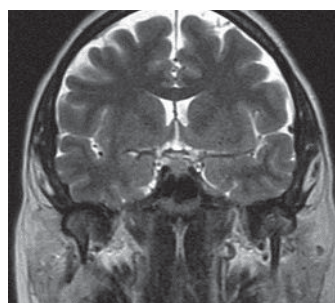
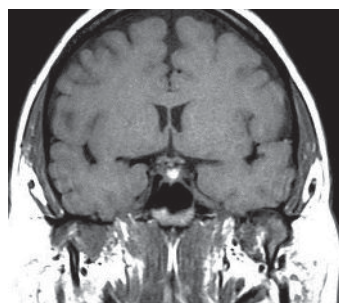
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	MR angiography head, CT angiography head, MR venography head, or CT venography head to evaluate for suspected vascular involvement or complications
●	FDG-PET or Thallium 201 SPECT, except to differentiate tumor from infection

CLINICAL NOTES

- Immunosuppressed individuals are at increased risk of infection, lymphoma, leukemia and complications of immunosuppressive therapy (Douglas et al. [ACR] 2014).

Cluster headaches/trigeminal autonomic cephalgias (SUNCT/SUNA, chronic paroxysmal hemicranias, and hemicrania continua):

●	MRI brain with and without IV contrast
●	MRI brain without IV contrast in patients who are unable to receive or refuse IV contrast
●	CT head with IV contrast or CT head with and without IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast in patients unable to undergo MRI and who are unable to receive or refuse IV contrast
●	MR angiography head following an MRI brain or CT angiography head following a CT head with IV contrast
●	MR venography; CT venography; SPECT; PET; MRI brain with IV contrast

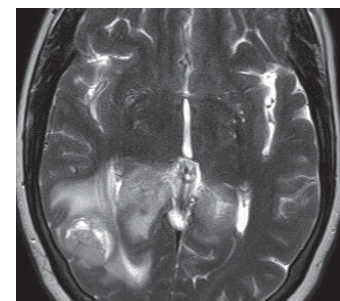
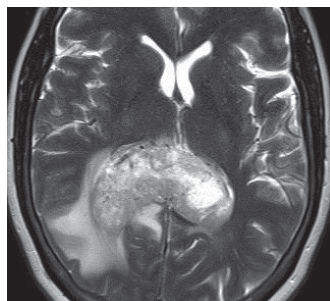


33-year-old female with long history of "migraine;" now increasing headache with partial third nerve palsy; asymmetric signal in left gasserian ganglion with enhancement.

- In patients with new onset cluster headache or another trigeminal autonomic cephalgia, hemicranias continua, or new daily persistent headache, specialist referral should be considered for investigation and treatment (*TOP Clinical Practice Guideline*; *SIGN* 2008; *NICE* 2015).
- Cluster headaches are associated with pituitary macroadenomas in 5-10% of patients. Therefore, an MRI of the brain is recommended at least once in the patient's lifetime (Douglas et al. [ACR] 2014).
- Head MRA and CTA are not usually indicated initially (Douglas et al. [ACR] 2014).

New headache in patients > 50 years old:

●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with IV contrast or CT head with and without IV contrast if the patient is unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast if there is suspicion of hemorrhage, if the patient is unable to undergo MRI, or if MRI is not available
●	MR angiography head, CT angiography head, MR venography head, or CT venography head if clinical or imaging suspicion of a vascular lesion
●	SPECT; PET; MRI brain with IV contrast



61-year-old female with two-month history of headache and dizziness; large glioblastoma right hemisphere and corpus callosum.

CLINICAL NOTES

- Trigeminal autonomic cephalgia is a group of primary headache disorders characterized by pain in unilateral trigeminal distribution in association with ipsilateral cranial autonomic signs and symptoms. Cluster headache is the only relatively common member of this family (Douglas et al. [ACR] 2014).
- Cluster headache is characterized by repeated (once every other day to eight times a day) short-lasting (15-180 minutes) but excruciating intense attacks of strictly unilateral periorbital pain associated with local autonomic symptoms or signs (Beithon et al. [ICSJ] 2013; Douglas et al. [ACR] 2014).
- The most striking feature of cluster headache is the unmistakable circadian and circannual periodicity (*SIGN* 2008).

CLINICAL NOTES

- Patients who present with headache and red flag features for potential secondary headache should be referred to a specialist appropriate to their symptoms for further assessment (*SIGN* 2008).

Headache with symptoms and signs of increased intracranial pressure, including papilledema:	
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast if the patient is unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast if there is suspicion of hemorrhage, if the patient is unable to undergo MRI, or if MRI is not available
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR venography head or CT venography head for suspected dural venous sinus thrombosis or idiopathic intracranial hypertension/pseudotumor cerebri
●	MR angiography head or CT angiography head to evaluate for a suspected vascular abnormality
●	SPECT; PET

CLINICAL NOTES

- The differential diagnosis of headache with papilledema includes any entity that results in increased intracranial pressure including tumor, abscess, hematoma, hydrocephalus, idiopathic intracranial hypertension (IIH) and dural venous sinus thrombosis (Douglas et al. [ACR] 2014).
- Headache with nausea and vomiting can be a sign of increased intracranial pressure and is usually worse in the morning. The presence of bilateral papilledema indicates increased intracranial pressure that is transmitted to the optic nerve sheath (Douglas et al. [ACR] 2014).
- Headache secondary to intracranial neoplasm has at least one of three features: progressive, worse in the morning/after daytime napping, or aggravated by Valsalva-like maneuvers (ICHD-3 2013).
- Patients with headache and features suggestive of raised intracranial pressure should be referred urgently to a specialist for assessment (SIGN 2008).

Suspected low CSF pressure headache/orthostatic headache:	
●	MRI brain with and without IV contrast
●	MRI brain without IV contrast in patients who are unable to receive or refuse IV contrast
●	CT head with IV contrast or CT head with and without IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast in patients unable to undergo MRI and who are unable to receive or refuse contrast
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR myelography or CT myelography of the spine in patients not responding to treatment
●	MR angiography; CT angiography; MR venography; CT venography; SPECT; PET

CLINICAL NOTES

- In patients with spontaneous or iatrogenic intracranial hypotension, the headache develops or worsens soon after assuming an upright posture and lessens or resolves shortly after lying down (SIGN 2008).
- Intracranial hypotension should be considered in all patients with headache developing or worsening after assuming an upright posture (SIGN 2008).
- Spontaneous intracranial hypotension typically results in orthostatic headache and low opening pressure on lumbar puncture (Douglas et al. [ACR] 2014). The main diagnostic criteria of spontaneous intracranial hypotension are the demonstration of extrathecal CSF with CT or MRI of the entire spine, which should include an MR myelography sequence. If no extrathecal CSF is present, then the presence of at least one of the following should indicate a diagnosis of spontaneous intracranial hypotension: low opening pressure on lumbar puncture, meningeal diverticulum, or improvement of symptoms with epidural blood patch (Douglas et al. [ACR] 2014).

Headache precipitated by cough:	
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast if there is suspicion for hemorrhage, if the patient is unable to undergo MRI, or if MRI is not readily available
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR angiography head or CT angiography head if there is suspicion of a vascular lesion/abnormality
●	SPECT; PET; MR venography; CT venography

CLINICAL NOTES

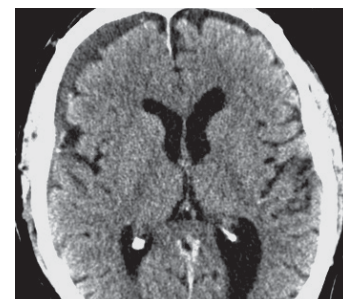
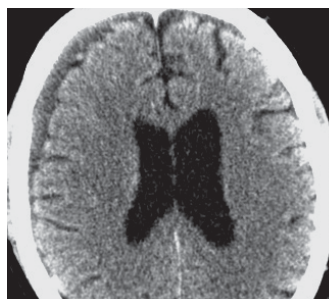
- The diagnostic criteria for a cough headache are at least two headaches brought on by or occurring only with coughing, straining and/or other Valsalva maneuvers, sudden onset, and lasting less than two hours (ICHD-3 2013).
- Symptomatic cough headache may represent a primary headache or may be a sign of an underlying structural abnormality, most commonly a Chiari I malformation or other posterior fossa lesions (Evers et al. [EFNS] 2011; SIGN 2008).
- Patients who present with headache and red flag features for potential secondary headache should be referred to a specialist appropriate to their symptoms for further assessment (SIGN 2008).
- Imaging studies reveal pathology in 10%-43% of cases of headaches associated with cough, exertion or sexual activity (Douglas et al. [ACR] 2014).

Headache precipitated by exertion or sexual activity:	
●	CT head without IV contrast or CT head with and without IV contrast
●	CT angiography head and/or neck or MR angiography head and/or neck with and/or without IV contrast
●	MRI brain without IV contrast or MRI brain with and without IV contrast
●	CT head with IV contrast, except to characterize abnormalities detected on previous CT head without IV contrast
●	MRI brain with IV contrast, except to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR venography; CT venography; SPECT; PET

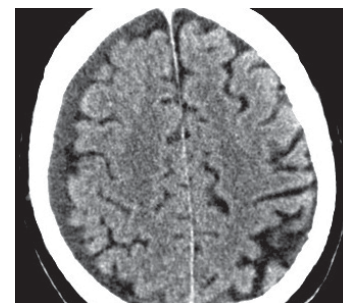
CLINICAL NOTES

- Primary exercise headache is usually precipitated by sustained physically strenuous exercise, and occurs more commonly in hot weather or at high altitude (*ICHD-3* 2013).
- Exertional headaches may be primary or secondary. Important differential diagnoses include subarachnoid hemorrhage, cervical artery dissection, and craniocervical abnormalities (Evers et al. [*EFNS*] 2011).
- Headaches associated with sexual activity may increase in intensity with increasing sexual excitement or may intensify just before or with orgasm (*ICHD-3* 2013).
- Headaches precipitated by sexual activity can be primary, however it is essential to exclude subarachnoid hemorrhage and arterial dissection at initial presentation (*SIGN* 2008; Douglas et al. [*ACR*] 2014; Evers et al. [*EFNS*] 2011).
- Patients who present with headache and red flag features for potential secondary headache should be referred to a specialist appropriate to their symptoms for further assessment (*SIGN* 2008).
- Imaging studies reveal pathology in 10%- 43% of cases of headaches associated with cough, exertion or sexual activity (Douglas et al. [*ACR*] 2014).
- If an MRI is obtained to evaluate a headache precipitated by exertion or sexual activity, it should include fluid-attenuated inversion recovery (FLAIR), gradient-recalled T2* and/or susceptibility weighted imaging (SWI) sequences (expert panel consensus opinion).

Persistent headache attributed to traumatic injury to the head:	
●	CT head without IV contrast
●	MRI brain with and without IV contrast or MRI brain without IV contrast for patients with new or increasing headache, new or increasing neurologic symptoms/signs, or increasing cognitive deficit
●	CT head with IV contrast for patients with new or increasing headache, new or increasing neurologic symptoms/signs, or increasing cognitive deficit and a previous negative CT without IV contrast who are unable to undergo MRI
●	MRI brain with IV contrast to characterize abnormalities seen on previous MRI brain without IV contrast
●	SPECT; PET; MR angiography; CT angiography; MR venography; CT venography



Delayed increasing headache with right mixed density subdural displacing brain.



CLINICAL NOTES

- Following traumatic brain injury (TBI), 50% or more of injured individuals experience headache. The majority of these are self-limited, but headache persisting for more than three months may occur (*CO Division of Workers/Compensation Medical Treatment Guidelines* 2012).
- Headaches may persist longer when associated with other symptoms such as dizziness, memory problems or weakness (*CO Division of Workers' Compensation Medical Treatment Guidelines* 2012).
- The purposes of imaging patients with chronic TBI are to improve identification of underlying injuries, to assist in patient prognosis, and to guide in the need for referral to a specialist (Shetty et al. [*ACR*] 2016).

REFERENCES

Complete references and evidence tables can be found on the CDI Quality Institute website: myCDI.com/PLE.

Appropriate Imaging for Patients with Headache

● = indicated, ● = indicated in specific scenarios, ● = probably not indicated, with limited exceptions, and ● = not indicated

Chronic headache (including migraine, tension, or medication overuse/rebound headaches) without a change in pattern, seizure, or neurological signs/symptoms:

●	MRI
●	CT
●	MR Angiography
●	CT Angiography
●	PET
●	SPECT

Headache with atypical features, an abrupt increase in severity/frequency, or an abrupt pattern change: OR Headache with neurologic signs/symptoms or seizures:

●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head with IV contrast if the patient is unable to undergo MRI, if MRI is not available, or to characterize abnormalities detected on previous CT head without contrast
●	CT head without IV contrast if there is suspicion of hemorrhage, if patient is unable to undergo MRI, or if MRI is not available
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR angiography head, CT angiography head, MR venography head, or CT venography head if clinical or imaging suspicion of a vascular lesion
●	SPECT; PET

Sudden onset of severe headache (thunderclap headache):

●	CT head without IV contrast or CT head with and without IV contrast
●	CT angiography head and neck or MR angiography head and neck with and/or without IV contrast
●	MRI brain without IV contrast or MRI brain with and without IV contrast
●	MR venography head or CT venography head in patients with suspected venous sinus thrombosis
●	CT head with IV contrast, except to characterize abnormalities detected on previous CT head without IV contrast
●	MRI brain with IV contrast, except to characterize abnormalities seen on a previous MRI brain without IV contrast
●	SPECT; PET

New headache with systemic symptoms, suspected encephalitis, or suspected meningitis:

●	CT head without IV contrast
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR angiography head, CT angiography head, MR venography head, or CT venography head to evaluate for suspected vascular involvement or vascular complications
●	SPECT; PET

New headache or change in headaches in a cancer/immunocompromised patient:

●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	MR angiography head, CT angiography head, MR venography head, or CT venography head to evaluate for suspected vascular involvement or complications
●	FDG-PET or Thallium 201 SPECT, except to differentiate tumor from infection

Cluster headaches/trigeminal autonomic cephalgias (SUNCT/SUNA, chronic paroxysmal hemicranias, and hemicrania continua):

●	MRI brain with and without IV contrast
●	MRI brain without IV contrast in patients who are unable to receive or refuse IV contrast
●	CT head with IV contrast or CT head with and without IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast in patients unable to undergo MRI and who are unable to receive or refuse IV contrast
●	MR angiography head following an MRI brain or CT angiography head following a CT head with IV contrast
●	MR venography; CT venography; SPECT; PET; MRI brain with IV contrast

Appropriate Imaging for Patients with Headache

● = indicated, ● = indicated in specific scenarios, ● = probably not indicated, with limited exceptions, and ● = not indicated

New headache in patients > 50 years old:	
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with IV contrast or CT head with and without IV contrast if the patient is unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast if there is suspicion of hemorrhage, if the patient is unable to undergo MRI, or if MRI is not available
●	MR angiography head, CT angiography head, MR venography head, or CT venography head if clinical or imaging suspicion of a vascular lesion
●	SPECT; PET; MRI brain with IV contrast

Headache with symptoms and signs of increased intracranial pressure, including papilledema:	
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast if the patient is unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast if there is suspicion of hemorrhage, if the patient is unable to undergo MRI, or if MRI is not available
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR venography head or CT venography head for suspected dural venous sinus thrombosis or idiopathic intracranial hypertension/pseudotumor cerebri
●	MR angiography head or CT angiography head to evaluate for a suspected vascular abnormality
●	SPECT; PET

Suspected low CSF pressure headache/orthostatic headache:	
●	MRI brain with and without IV contrast
●	MRI brain without IV contrast in patients who are unable to receive or refuse IV contrast
●	CT head with IV contrast or CT head with and without IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast in patients unable to undergo MRI and who are unable to receive or refuse contrast
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR myelography or CT myelography of the spine in patients not responding to treatment
●	MR angiography; CT angiography; MR venography; CT venography; SPECT; PET

Headache precipitated by cough:	
●	MRI brain with and without IV contrast or MRI brain without IV contrast
●	CT head with and without IV contrast or CT head with IV contrast in patients unable to undergo MRI or if MRI is unavailable
●	CT head without IV contrast if there is suspicion for hemorrhage, if the patient is unable to undergo MRI, or if MRI is not readily available
●	MRI brain with IV contrast to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR angiography head or CT angiography head if there is suspicion of a vascular lesion/abnormality
●	SPECT; PET; MR venography; CT venography

Headache precipitated by exertion or sexual activity:	
●	CT head without IV contrast or CT head with and without IV contrast
●	CT angiography head and/or neck or MR angiography head and/or neck with and/or without IV contrast
●	MRI brain without IV contrast or MRI brain with and without IV contrast
●	CT head with IV contrast, except to characterize abnormalities detected on previous CT head without IV contrast
●	MRI brain with IV contrast, except to characterize abnormalities seen on a previous MRI brain without IV contrast
●	MR venography; CT venography; SPECT; PET

Persistent headache attributed to traumatic injury to the head:	
●	CT head without IV contrast
●	MRI brain with and without IV contrast or MRI brain without IV contrast for patients with new or increasing headache, new or increasing neurologic symptoms/signs, or increasing cognitive deficit
●	CT head with IV contrast for patients with new or increasing headache, new or increasing neurologic symptoms/signs, or increasing cognitive deficit and a previous negative CT without IV contrast who are unable to undergo MRI
●	MRI brain with IV contrast to characterize abnormalities seen on previous MRI brain without IV contrast
●	SPECT; PET; MR angiography; CT angiography; MR venography; CT venography