Headache in the Emergency Department

Avoiding Misdiagnosis of Dangerous Secondary Causes, An Update

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KEYWORDS

• Secondary headaches • Emergency medicine • Misdiagnosis

KEY POINTS

- There are several dangerous secondary causes of headaches that emergency physicians must consider in patients presenting with acute headache.
- Careful history and physical examination targeted at these important secondary causes of headache will help to avoid misdiagnosis in these patients.
- Secondary headaches are rare, "can't miss" diagnoses with often variable and atypical presentations.

NATURE OF THE PROBLEM/DEFINITION

Headache is the seventh most common chief complaint in the emergency department (ED), comprising approximately 2.5% of all ED visits in the United States.[1] Depending on its underlying cause, headache can be broadly categorized as either primary or secondary. The International Classification of Headache Disorders (ICHD) identifies primary headaches as migraine, tension-type, cluster, or one of the other trigeminal autonomic cephalgias.[2] Primary headaches comprise the vast majority of all headaches.[3] Secondary headaches are defined as those due to a distinctive underlying disorder, such as trauma, infection, or malignancy.[2] Evaluation of the patient with headache in the ED is focused on the alleviation of pain and the consideration of dangerous secondary causes.

A sophisticated clinical approach must be used to determine which patients require expedited neuroimaging or further diagnostic evaluation for potential secondary

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headache. An in-depth understanding of several specific pathologic entities, many of them rare, is necessary to identify serious disease without the overuse of diagnostic resources in patients with primary and benign presentations.[4] Moreover, in some cases, misdiagnosis of a particular type of secondary headache may lead to treatment that is deleterious to the patient.

GENERAL APPROACH TO THE PATIENT WITH HEADACHE

The first goal of the emergency physician (EP), if the patient is stable, will be targeted toward relieving the patient's pain. Individual studies and consensus recommendations advise treating primary headaches preferentially with nonopioid medications (American College of Emergency Physician [ACEP] Level A Recommendation).[5] It is important to note that primary and secondary headaches cannot reliably be differentiated based on response to analgesic therapy.[6] A multitude of life-threatening causes of secondary headache, including subarachnoid hemorrhage (SAH) and cervical artery dissection (CeAD), has been reported to respond to simple analgesic and antimigraine medications.[7–14] As the patient's pain is being addressed, the EP considers secondary causes that warrant further workup and intervention. **Table 1** illustrates the most critical secondary diagnoses to consider in the patient with undifferentiated headache, along with key clinical features, and diagnostic and treatment considerations.

The 2008 ACEP clinical policy on acute headache evaluation describes 4 specific groups that deserve special attention and may warrant neuroimaging in the ED setting (**Table 2**).[6] Although the authors advocate adherence to these guidelines, they aim to highlight additional high-risk presentations and diagnoses, each of which should be evaluated within its own unique clinical context. In 2019, ACEP revisited the topic of headache in the ED to address related questions from the 2009 guidelines (**Table 3**). These recommendations are also addressed in this article, as is pertinent.[5]

DANGEROUS CAUSES OF SECONDARY HEADACHE

Subarachnoid Hemorrhage

SAH is among the most important considerations in patients presenting with headache. Onset can occur during physical exertion, such as exercise or during coitus, but such a trigger is noted in only approximately 20% of cases.[15] The classic clinical picture is one of sudden and severe headache that is maximal at onset.[16] Approximately 8% of patients presenting to the ED with a thunderclap headache are diagnosed with SAH.[17,18] The timeframe for what is considered thunderclap varies in the literature, up to even 1 hour in some studies.[19–21] However, the ICHD defines it as peaking within seconds to a minute.[2] Agreement between providers on the presence of a "thunderclap headache" for a particular patient is poor.[18] Other important clinical features include vomiting, neck stiffness, seizure, neurologic deficits, syncope, and alteration in mental status or coma.[19]

Although a thunderclap headache is a hallmark symptom for SAH, other causes of secondary headache should also be considered based on the patient's presentation, including cerebral venous thrombosis, CeAD, hemorrhagic stroke, posterior reversible encephalopathy syndrome, acute angle closure glaucoma (AACG), pituitary apoplexy, third ventricle colloid cysts, and reversible cerebral vasoconstriction syndrome.

In recent years, the Ottawa Subarachnoid Hemorrhage Rule has been derived and validated with a sensitivity of 100%, to aid the clinician in evaluating patients for SAH.[19,20,22,23] In addition, other studies have shown that it is possible to rule out SAH without lumbar puncture (LP) if a third-generation (or higher) computed tomographic (CT) scan is performed within 6 hours of symptom onset of a thunderclap

Table 1
Dangerous causes of secondary headache

Diagnosis	Clinical Features	Diagnostic Testing	Interventions	Additional Comments
Subarachnoid hemorrhage (SAH)	Severe, sudden onset headache Different than other headaches	CT Head Lumbar puncture	Neurosurgical consultation Blood pressure control Nimodipine Ventriculostomy	CT has highest sensitivity in first 6 h, then decreases after that Important to consider other causes of thunderclap headache
Cervical artery dissection (CeAD) Internal carotid artery dissection (ICAD) OR Vertebral artery dissection (VAD)	New onset head, neck, or facial pain ICAD: Anterior circulation ischemia, Horner syndrome, cranial nerve abnormalities, or monocular vision loss VAD: Posterior circulation ischemia	CT Head/Neck angiography	Anticoagulation vs antiplatelet Consider thrombolytics in early ischemic stroke and extracranial dissection	Neurologic symptoms can be delayed after headache onset Rule out concomitant SAH before initiating anticoagulation Traumatic mechanism in 40%
Giant cell arteritis (GCA)	Headache in age >50 Polymyalgia rheumatica association Temporal artery abnormalities on examination Jaw claudication Visual loss (mainly monocular) Fevers	ESR (cannot rule out if normal) Temporal artery biopsy	Systemic glucocorticoid therapy	When suspicion high, start steroid therapy while awaiting ESR/biopsy results Consider GCA and perform thorough head, neck, and ophthalmologic evaluation in elderly patients with fever of unknown source
Cerebral venous thrombosis (CVT)	Headache + signs of increased ICP or focal neurologic deficits	CT or MR venogram	Anticoagulation Endovascular thrombectomy if progressive symptoms despite anticoagulation	Highest risk if history of oral contraceptive, pregnancy/postpartum, thrombophilia

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Table 1
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Diagnosis	Clinical Features	Diagnostic Testing	Interventions	Additional Comments
Idiopathic intracranial hypertension (IIH)	Most common in young, obese women in third or fourth decade of life Headache, vision loss, papilledema, transient visual obscurations, pulsatile tinnitus	Neuroimaging to rule out other space-occupying lesions Lumbar puncture with opening pressure >20 mm Hg	Weight loss Acetazolamide or Furosemide Optic nerve fenestration or CNS shunt if progressive vision loss	Cranial VI (abducens) palsy in at-risk patient population is suggestive Treat to prevent visual loss in 25% of patients
Acute angle closure glaucoma (AACG)	Acute onset monocular pain, headache, redness, decreased vision ± nausea vomiting Mid-fixed dilated pupil, "steamy cornea"	Ocular pressure >21 mm Hg (most often >30 mm Hg)	Ophthalmologic consultation Pressure-lowering eye drops Systemic osmotic therapy	Perform an eye examination on alert patients with dilated pupil and sudden onset severe headache (can mimic SAH with posterior communicating artery aneurysm)
Bacterial meningitis	Fever, headache, altered mental status, nuchal rigidity	Lumbar puncture (± CT Head, see 2008 ACEP Clinical Policy on Acute Headache)	IV antibiotics Consider IV dexamethasone	Jolt accentuation, Brudzinski sign, Kernig sign, nuchal rigidity all are poorly sensitive physical examination findings
Preeclampsia	Headache in pregnancy >20 +/− visual symptoms, abdominal pain, chest pain, shortness of breath, vomiting	Systolic blood pressure >140 mm Hg or diastolic blood pressure >110 on 2 occasions + Any of the following: Proteinuria, thrombocytopenia, renal insufficiency, impaired liver function, pulmonary	Obstetric consultation Urgent delivery if severe symptoms Blood pressure management IV Magnesium	Must consider diagnosis up to 6 wk postpartum, highest risk in first week postdelivery

		edema, cerebral or visual disturbances		
Pituitary apoplexy	Severe headache Visual complaints, vomiting +/− hypopituitarism	CT Head noncontrast for hemorrhage MRI for pituitary mass	Neurosurgical consultation Systemic glucocorticoids for any adrenal insufficiency	Ocular paresis can occur, affecting CN III, IV, or VI (most commonly CN III)
Carbon monoxide poisoning	Flulike illness; worse each morning Mild: headache, nausea, myalgia, dizzy Severe: confusion, syncope, neurologic deficits, death	Arterial blood gas cooximetry	Non-rebreather oxygen +/− hyperbaric oxygen chamber therapy	Consider when multiple patients from same household have similar symptoms Hyperbaric oxygen therapy is indicated for neurologic or cardiovascular signs and above certain cutoffs
Space-occupying lesions	Progressively worsening headache History of malignancy Worse in morning or in head-down position	CT Head MRI	Neurosurgical consultation ICP-lowering therapies Lesion-specific therapies	Emergent ICP-lowering therapies may include elevating head of bed, diuretics, and hyperventilation Lesion-specific therapies may include operative intervention, corticosteroids, and antimicrobial agents
Occult trauma	Signs of abuse or neglect Anticoagulation or coagulopathy	CT Head	Neurosurgical consultation	Patients in at-risk populations (eg, abuse) may not volunteer a history of trauma
Reversal cerebral vasoconstriction syndrome (RCVS)	Thunderclap headaches resolving within minutes or hours	CT or MR angiography	Supportive care, monitoring in	Ischemic or hemorrhagic strokes can occur in 20% of patients

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Table 1
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Diagnosis	Clinical Features	Diagnostic Testing	Interventions	Additional Comments
	Multiple recurrent sudden, severe exacerbations are highly suggestive		neurosurgical intensive care unit	Postpartum period is a risk factor (occurs in other patient populations as well)
Cerebellar infarction	Headache with dizziness Cerebellar signs Cranial nerve abnormalities	CT Head MRI	Neurologic/neurosurgical consultation	Although CT Head is insensitive for infarction, it is helpful initially to rule out hemorrhage and identify life-threatening edema and mass effect

Table 2
2008 American College of Emergency Physician clinical policy: which patients with headache require neuroimaging in the ED?

Patient Presentation	Recommendation Level
Headache + new abnormal findings in a neurologic examination (eg, focal deficit, altered mental status, altered cognitive function)	Level B Recommendation [a](emergent noncontrast head CT)
New sudden-onset severe headache	Level B Recommendation [a](emergent noncontrast head CT)
HIV-positive patients with a new type of headache	Level B Recommendation [a](emergent noncontrast head CT)
Age >50 with new headache but with normal neurologic examination	Level C Recommendation [b](urgent noncontrast head CT)

Routine studies are indicated when the study is not considered necessary to make a disposition in the ED.

[a] *Emergent studies* are those essential for a timely decision regarding potentially life-threatening or severely disabling entities.

[b] *Urgent studies* are those that are arranged before discharge from the ED (scan appointment is included in the disposition).

Edlow JA, Panagos PD, Godwin SA, Thomas TL, Decker WW; American College of Emergency Physicians. Clinical policy: critical issues in the evaluation and management of adult patients presenting to the emergency department with acute headache. Ann Emerg Med. 2008 Oct;52(4):407-36.

headache, and interpreted by a radiologist experienced with cranial CT.[21,24–26] The most recent 2019 ACEP Clinical Policy on headaches supports the use of the aforementioned approaches to evaluate SAH in patients who present to the ED (Level B Recommendations).[5]

Currently, the gold standard in the diagnosis of SAH is by cerebrospinal fluid (CSF) analysis. However, in the event that a patient requires further testing after a negative noncontrast head CT, both LP and CT angiography (CTA) of the head are reasonable options to rule out SAH (ACEP Level C Recommendation).[5,27,28] Both have pros and cons that limit their diagnostic yield. Traumatic LPs complicate the interpretation of the CSF results, which may lead to even further testing. CTA has very good sensitivity for detecting aneurysms larger than 3 mm, potentially identifying more than 99% of aneurysmal SAH.[29,30] However, this approach has the unintended consequence of identifying asymptomatic aneurysms that do not require neurosurgical intervention.[31–33] A shared decision-making model informing the patient of potential risks and benefits of each diagnostic approach should be used on an individual basis.

Cervical Artery Dissection

CeAD is an important but difficult cause of headache to diagnose in the ED. CeAD includes both internal carotid artery dissection (ICAD) and vertebral artery dissection (VAD). ICAD is estimated as the underlying cause of 2% of all cases of stroke and up to 24% of strokes in children and young adults.[34–36] Both subtypes of CeAD are linked to preceding cervical trauma, such as vigorous physical activity, coughing, sneezing, or chiropractic manipulation in approximately 40% of cases, although recent studies question the association of chiropractic cervical manipulation and CeAD.[37,38] Headache in CeAD is a prominent symptom in approximately 70% of cases, but patients also may present with isolated neck or facial pain on the ipsilateral side of the dissected artery.[39,40] Perhaps the biggest obstacle to prompt diagnosis of CeAD is the delayed onset of neurologic symptoms, with median times ranging from

Table 3
2019 American College of Emergency Physician clinical policy: which patients with headache require neuroimaging in the ED?

Patient Presentation	Recommendation Level
In the adult ED patient presenting with acute headache, are there risk-stratification strategies that reliably identify the need for emergent neuroimaging?	Level B Recommendation Use the Ottawa Subarachnoid Hemorrhage Rule as a decision rule that has high sensitivity to rule out SAH, but low specificity to rule in SAH, for patients presenting to the ED with a normal neurologic examination result and peak headache severity within 1 h of onset of pain symptoms
In the adult ED patient treated for acute primary headache, are nonopioids preferred to opioid medications?	Level A Recommendation Preferentially use nonopioid medications in the treatment of acute primary headaches in ED patients
In the adult ED patient presenting with acute headache, does a normal noncontrast head CT scan performed within 6 h of headache onset preclude the need for further diagnostic workup for SAH?	Level B Recommendation Use a normal noncontrast head CT[a] performed within 6 h of symptom onset in an ED headache patient with a normal neurologic examination, to rule out nontraumatic SAH
In the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT, is CTA of the head as effective as lumbar puncture to safely rule out SAH?	Level C Recommendation Perform lumbar puncture or CTA to safely rule out SAH in the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT result Use shared decision making to select the best modality for each patient after weighing the potential for false positive imaging and the pros and cons associated with lumbar puncture

[a] Minimum third-generation scanner.

American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Acute Headache:, Godwin SA, Cherkas DS, et al. Clinical Policy: Critical Issues in the Evaluation and Management of Adult Patients Presenting to the Emergency Department With Acute Headache. Ann Emerg Med 2019;74(4):e41-e74.

4 days in patients with ICAD and 14.5 hours in patients with VAD.[39,41] Further complicating the situation, patients older than 60 years may not present with the aforementioned traditional symptoms and risk factors.[42]

In the large, observational CADISP (Cervical Artery Dissection and Ischemic Stroke Patients) study, patients with ICAD presented with cerebral ischemic symptoms 73% of the time and patients with VAD presented with cerebral ischemic symptoms in 90% of cases.[43] Patients with ICAD typically present with anterior circulation ischemic symptoms (painful complete or partial Horner syndrome, painful cranial nerve XII palsy, painful sudden onset pulsatile tinnitus, and permanent or transient monocular vision loss secondary to ischemia), whereas VAD classically presents with posterior circulation ischemic deficits (dizziness/vertigo with or without neurologic deficits, such as ataxia, diplopia, and dysarthria).[2,44] In ICAD, cranial nerve palsies are less

common, but the hypoglossal (XII) nerve is most frequently affected in isolation or in combination with other lower cranial nerves IX to XI.[45] CeAD that presents with headache, or facial or neck pain alone is especially challenging. In these cases, the only clinical clues may lie in a concerning mechanism and a typical pattern of pain.

Diagnosis is confirmed via MRI/magnetic resonance angiography (MRA) or CTA.[46,47] The sensitivity for ultrasound in the diagnosis of CeAD ranges from 70% to 86%, and therefore, the provider should pursue more advanced CTA or MRA studies if clinical suspicion exists.[48] Ideally, if the diagnosis can be made before the development of neurologic deficits, a window of opportunity exists to prevent a poor clinical outcome.[49]

Giant Cell Arteritis

Giant cell arteritis (GCA), or temporal arteritis, is a vasculitis of medium and large vessels and is the most common cause of systemic vasculitis in patients older than 50 in North America and Europe.[50] The most important risk factor in GCA is age, as disease almost never develops in patients younger than 50, with most patients developing GCA after 70 years of age.[51–53]

Headache is the most critical clinical feature, occurring in 83% of patients with GCA. The American College of Rheumatology classification for diagnosis of GCA requires 3 of the following 5 diagnostic criteria: age $\geq$50 years, new-onset localized headache, temporal artery tenderness or decreased temporal artery pulse, erythrocyte sedimentation rate (ESR) $\geq$ 50 mm/h, and abnormal temporal artery biopsy.[54] ESR levels may suggest the presence of GCA, but 5% of patients with biopsy-confirmed GCA can have normal ESR levels. Therefore, a negative ESR cannot reliably rule out the disease.[52,55] C-reactive protein greater than 2.45 mg/dL and thrombocytosis greater than 400,000 increase the likelihood of a positive biopsy for GCA and may be helpful in the diagnosis, but similar to ESR, a normal result does not definitively rule out the diagnosis.[56]

Other important features include the presence of Polymyalgia rheumatica, temporal artery abnormalities (tender, nodular, swollen, thickened arteries, and/or decreased pulse), jaw claudication, fevers, and visual loss.[57] The presence of unexplained anemia or constitutional symptoms of fever, weight loss, or malaise may also provide additional clues. In a review of elderly patients with fever of unknown origin, GCA was the most frequent specific ultimate diagnosis, accounting for 17% of cases.[58]

Imaging studies, such as ultrasound or MRI of the temporal artery, at an institution with experience in these techniques, may play some role in the future for diagnosis of this disease.[59,60] However, the utility of these imaging studies in routine clinical care is not yet clear.

Transient monocular visual impairment or diplopia can be an early manifestation of GCA, although in 10% of patients, binocular visual changes are present.[61] If GCA is strongly suspected, empiric treatment with corticosteroids should be started and ophthalmology consult for temporal artery biopsy should be obtained. Initiation of steroid therapy should not be delayed in awaiting temporal biopsy if suspicion for GCA is high, as biopsy results will not be affected for at least 1 week.[62]

Cerebral Vein and Sinus Thrombosis

Cerebral vein and sinus thrombosis (CVT) is a rare form of stroke that can occur at any age with a mean age of approximately 40 years.[63] Oral contraceptive use (especially in obese patients) and thrombophilia are common risk factors for development of CVT.[64] Several additional risk factors have been identified, including pregnancy and

postpartum states, malignancy, as well as infections, particularly those involving the ears, sinus, mouth, face, and neck.[63,65]

In the large multicenter cerebral venous thrombosis (VENOST) study, headache was the most common presenting complaint in cases of CVT, occurring in approximately 90% of cases.[66] It is the sole symptom, however, in only 25% of cases.[63,66,67] The headache is most typically slow and progressive in onset but may have a thunderclap presentation in a minority of patients.[68,69] The average time delay from presentation to diagnosis is 7 days, and a careful evaluation for signs of increased intracranial pressure (ICP) or focal brain injury is needed to identify patients with CVT.[63] Signs of increased ICP, such as papilledema or a cranial nerve VI (abducens) palsy, may suggest superior sagittal sinus thrombosis, the most commonly affected location in CVT.[70] A wide range of additional focal neurologic deficits can develop depending on the location of infarction or secondary hemorrhage, including aphasia, unilateral or bilateral weakness, and altered mental status. Rapid neurologic deterioration with stupor and coma has been noted in up to 18% of cases, whereas seizures are found in up to 40% of patients.[63] Finally, one-third of patients with CVT develop intracerebral hemorrhage, placing them at risk for worse outcomes.[66,71]

Several metaanalyses have investigated the utility of D-dimer in screening patients for CVT. Results are variable between the analyzed studies, with sensitivities ranging from 58% to 97%.[72,73] Given the high variability and low sensitivities in some studies, a normal D-dimer should not be relied on for ruling out CVT. Initial neuroimaging will often include CT or MRI of the brain. Unfortunately, neither CT nor MRI effectively rule out CVT, and further workup with CT or MR venography is recommended when clinical suspicion is high.[74]

Idiopathic Intracranial Hypertension

Idiopathic intracranial hypertension (IIH) is characterized by an elevation of ICP (CSF >20 cm H_2O), with normal ventricles and CSF analysis and in the absence of space-occupying lesions.[75] It is most common in young, obese women in the third or fourth decade of life.[76] Headaches in IIH can be severe and disabling, and there is a risk of permanent visual loss in the absence of therapeutic intervention.[77] Headaches occur in most patients with IIH with variable, nonspecific features. Associated symptoms include transient visual obscurations, pulsatile tinnitus, photopsia, and occasional radicular shoulder and arm pains.[76] Transient visual obscurations are described as brief episodes of monocular or binocular visual loss followed by full recovery.[78] Pulsatile tinnitus is seen in approximately one-half of patients and is likely due to turbulent blood flow through a stenotic venous sinus.[76] Physical examination should involve a search for papilledema, peripheral visual field defects, and unilateral or bilateral cranial nerve VI (abducens) palsy. The key to diagnosis in IIH is an elevated opening pressure by LP in the absence of space-occupying lesions on neuroimaging. There is a link between IIH and CVT; a negative CT or MRI in combination with elevated opening pressures may warrant further workup with venography to evaluate for potential CVT.[79]

Acute Angle Closure Glaucoma

AACG develops when the anterior chamber angle is narrowed, obstructing the flow of aqueous humor and leading to increased intraocular pressure (IOP). Patients older than 50 years are at risk for AACG, and its peak incidence occurs in patients older than 70.[80] Pupillary dilation resulting from any cause (eg, a dimly lit room) can precipitate an attack.

Clinically, patients present with abrupt-onset eye pain, blurry vision, and headache. They may additionally complain of nausea and vomiting. The typical physical examination reveals a mid-fixed dilated pupil with decreased visual acuity, injected conjunctiva, and corneal edema.[81] Ocular pressures greater than 21 mm Hg are necessary to make the diagnosis, and IOP is typically 30 mm Hg or higher. Once identified, medical and surgical therapy should be targeted at reducing the IOP to prevent permanent visual loss.[82]

Bacterial Meningitis

Meningitis can result from a bacterial, viral, fungal, parasitic, or noninfectious cause. Of these, bacterial meningitis is of particular concern and is associated with high mortality (approximately 15%).[83]

The classic triad of altered mental status, fever, and neck stiffness is present in only 44% of cases.[84] However, 99% of patients with bacterial meningitis will have at least 1 of these 3 classic symptoms, and 95% present with 2 of the following: headache, fever, neck stiffness, altered mental status.[84] Many patients with bacterial meningitis have preceding ear, sinus, or lung infections.[85]

Physical examination findings for bacterial meningitis have included the Kernig sign, Brudzinski sign, nuchal rigidity, and jolt accentuation.[86] A prospective analysis of these tests for meningitis found that jolt accentuation has a sensitivity of 21% with a specificity of 82%. Nuchal rigidity was found to have a sensitivity of 13% with a specificity of 80%. Kernig and Brudzinski signs both were found to have very low sensitivities of 2% with specificities of 97% and 98%, respectively.[87] Although these findings may help suggest the diagnosis of bacterial meningitis, the absence of these findings cannot rule out the disease, and CSF analysis is necessary for appropriate evaluation. Treatment with antimicrobials should not be delayed for CT, LP, or CSF results.[88]

Traditionally, a CT scan of the brain has been considered standard practice before performing an LP in order to identify central lesions that may theoretically increase the risk of postprocedure brainstem herniation. However, certain patient subsets are at increased risk for elevated ICP, and these patients should likely undergo neuroimaging before LP (ACEP Level C Recommendation; see **Table 2**). Specifically, cranial CT before LP should be considered in any patient with any of the following features: 60 years or older, immune-compromised, history of central nervous system (CNS) disease, recent seizures, altered mental status, focal neurologic deficit, or papilledema, as these patients may have a higher potential risk of brain herniation with LP.[88–90] Adherence to these criteria should be strongly considered to expedite time to diagnosis and treatment without increasing cost and unnecessary exposure of the patient to radiation.[91]

Preeclampsia

Preeclampsia is considered in the newly hypertensive patient after 20 weeks' gestation up to 6 weeks postpartum and affects approximately 5% of all pregnancies.[92] A systolic blood pressure greater than 140 mm Hg or diastolic blood pressure greater than 90 mm Hg on 2 occasions in combination with either proteinuria or end-organ damage is diagnostic.[93] The American College of Obstetricians and Gynecologists (ACOG) updated their criteria in 2013, and proteinuria is no longer an essential component for diagnosis if new onset of any of the following findings is present: thrombocytopenia, renal insufficiency, impaired liver function, pulmonary edema, or cerebral or visual disturbance.[93] Any patient at greater than 20 weeks' gestation meeting the ACOG criteria with new-onset headache should be identified as having preeclampsia,

and urgent consultation and treatment should be considered. In addition, a high index of suspicion should be maintained for the diagnoses of preeclampsia and eclampsia, as up to one-third of pregnant patients with new-onset or atypical headaches will carry the diagnosis of preeclampsia.[94,95]

Pituitary Apoplexy

Pituitary apoplexy is an acute ischemic or hemorrhagic infarction of the pituitary gland, occurring in patients with pituitary adenomas.[96] Underlying risk factors for apoplexy are identified in only 25% to 40% of patients, and they include pregnancy, head trauma, pituitary radiation, major surgery, and treatment with dopamine agonists.[96–98]

The clinical presentation of pituitary apoplexy is widely variable, from benign to catastrophic. The typical patient complains of severe headache, vomiting, and visual complaints. The headache can often present as sudden and severe in its onset, mimicking SAH.[99] Patients also may present with infectious-type symptoms of fever, meningeal irritation, and alteration in mental status. The visual symptoms can manifest as decreased visual acuity or visual field defects in 75% of patients, with ocular paresis occurring in approximately 70%.[98] Ocular paresis can develop as a result of compression of the cavernous sinus and associated cranial nerves III, IV, and VI. Of these, cranial nerve III (oculomotor) is most susceptible to compression.[99] Finally, at time of presentation, patients may demonstrate evidence of hypopituitarism, and any evidence of glucocorticoid deficiency in the form of hypoglycemia, hypotension, or hyponatremia will require replacement with intravenous (IV) hydrocortisone.[98] The initial diagnostic test for evaluation of pituitary apoplexy will often be a noncontrast CT of the head to rule out SAH. Although noncontrast CT is sensitive for acute hemorrhage, MRI should be pursued if CT is negative to detect infarction.[100,101]

Carbon Monoxide Poisoning

Carbon monoxide (CO) poisonings account for approximately 50,000 ED visits per year in the United States.[102] CO poisoning is a dangerous underlying cause of headache; most cases are related to smoke inhalation, but faulty furnaces, inadequate ventilation of heating sources, and exposure to engine exhaust are also important causes.[103] Mild exposures may cause headaches, myalgias, dizziness, and neuropsychological impairment.[104,105] More severe exposures can result in alteration of mental status, focal neurologic deficits, loss of consciousness, or death.[103] Delayed neurologic sequelae and neuropsychiatric effects also may result.[106,107]

In the ED, the patient with headache and recent potential exposure must be evaluated for CO poisoning, particularly when multiple household members or pets also are ill. Pulse oximetry (Spo_2) is unable to distinguish between oxyhemoglobin and carboxyhemoglobin and thus cannot reliably screen for CO exposure.[108] Therefore, co-oximetry via serum blood gas analysis is needed to measure elevated carboxyhemoglobin levels. Once identified, oxygen by non-rebreather mask should be initiated and consideration given to hyperbaric oxygen treatment.[109]

Space-Occupying Lesion

Headache in the patient with history of malignancy can occur from a variety of causes, including the mass effect of the tumor itself or as a result of the therapy.[110] Although traditional teaching holds that a morning or nocturnal headache can be suggestive of intracranial malignancy, this pattern is actually uncommon in adult patients, with nausea, vomiting, and neurologic abnormalities being far more common.[110,111] Both primary and metastatic tumors are equally likely to cause headache at a rate of approximately 60%.[112] The most common primary sites for metastases to the brain

are as follows: lung (19.9%), melanoma (6.9%), renal (6.5%), breast (5.1%), and colorectal (1.8%).[113] It is important to note that brain cancer rarely presents with headache as its sole presenting feature, occurring in only 2% to 8% of patients.[114] Most patients with primary or metastatic disease will demonstrate concomitant neurologic deficits, neuropsychiatric disorders, or seizures. Initial evaluation should include a complete physical examination to evaluate for signs of increased ICP, such as neurologic deficits, visual field defects, and optic disc edema. For most neurooncology applications, MRI is superior to CT imaging, as MRI provides better anatomic resolution.[115] However, in the ED, a CT has the advantage of speed and convenience and can be used to initially evaluate for signs of increased ICP or secondary hemorrhage from a brain tumor.

In addition to pain caused by the tumor itself, patients with intracranial malignancy are at risk for intracranial hemorrhage. Approximately 1% to 11% of intracranial hemorrhage cases are secondary to malignancy, most commonly from metastatic solid tumors. Therefore, new headaches in patients with identified tumors should be further investigated via neuroimaging.[116] Finally, patients receiving chemotherapeutic agents or radiation therapy and those who have received a craniotomy can all present with the onset of a new type of headache. In such patients, the clinician should first evaluate the possibility of other more serious causes before attributing the symptoms to therapeutic interventions.

DISCLOSURE

The authors have nothing to disclose.

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