

## Aerospace Medicine Clinic

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You are the flight surgeon attached to a U.S. Air Force flying squadron. A healthy and experienced 32-yr-old male heavy-lift aircraft pilot presents to the Flight Medicine clinic with persistent headache, which he woke with 2 d prior. He described his headache as constant, rated 5/10 in the left frontotemporal area, and not responsive to his usual self-treatment with one dose of acetaminophen, hydration, and rest. In the clinic, the aviator denies any recent trauma, changes in exercise/activity, or changes in his diet/cafeine intake. He does admit to moderate increase in work stress recently but finds his stress level manageable overall. The aviator denies dizziness or vertigo, vision changes, hearing changes, motor changes, sensory changes, balance issues, nausea/vomiting, or cognitive difficulty. Although the pain has been distracting, he denies any difference from his usual headache. He also denies aura, photophobia, and phonophobia.

The aviator states this is not the worst headache of his life, and the headache was not described as “thunderclap” or sudden onset. He denies any significant past medical, surgical, or family history. He admits to drinking moderately but denies any tobacco use. The aviator is actively flying in a multiseat, non-ejection aircraft, but feels current symptoms would prevent him from performing flying duties safely. His physical examination and vitals are unremarkable with no neurological deficits, vision changes, weakness, or balance concerns. He was treated initially with battlefield acupuncture, with improvement in his symptoms to 2/10. The aviator was advised to increase his acetaminophen dose and follow up in 24–48 h if symptoms had not completely resolved.

The next day, he returned to clinic with unchanged symptoms but now endorsing a sensation of “being outside my body,” which was causing increased concern. Exam remained unchanged during this visit. Labs were ordered, including a complete blood count and comprehensive metabolic panel, and computed tomography (CT) imaging of the head without contrast was scheduled. That evening while calling with normal results of labs, you discover the member is being transported by ambulance to a local hospital due to symptoms of sudden left-sided paresthesia and slurred speech. Upon arrival at the emergency room, the aviator’s symptoms of paresthesia and

slurred speech have resolved. Vital signs and exam are normal. A CT of the head is obtained, revealing a 3-cm hemorrhagic lesion with surrounding vasogenic edema and midline shift. Additional imaging, including brain CT angiography and brain magnetic resonance imaging (MRI), further defines the mass. Imaging of chest, abdomen, pelvis, and scrotum rules out an extracranial primary tumor.

Neurosurgery is consulted, and the aviator is taken to the operating room where craniotomy with surgical resection of the mass is performed. A final diagnosis of multiple cerebral cavernous malformations (CCMs) is given. Post-surgery, the aviator recovers well and, on follow-up, has neither residual deficits nor abnormal findings on exam. The cause of the cavernous malformations is determined to be genetic. He is coming to you seeking a waiver to return to flying duties.

1. When evaluating an aviator who presents with headache in the clinic, what should be the first step in your evaluation?
  - A. Ask for aviator’s mental health history.
  - B. Ask about family history of cancer.
  - C. Evaluate for headache red flags.
  - D. Ask about recent immunizations.

### ANSWER/DISCUSSION

1. C. Initial headache evaluation should always begin with a careful history and assessment to rule out red flags and other secondary causes. A helpful mnemonic for headache red flags is SNNOOP10:

- Systemic symptoms including fever.
- Neoplasm history.
- Neurological deficit (including decreased consciousness).
- Onset is sudden or abrupt.
- Older age (onset after 50 yr of age).
- Pattern change or recent onset of new headache.

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- Positional headache.
- Precipitated by sneezing, coughing, or exercise.
- Papilledema.
- Progressive headache and atypical presentations.
- Pregnancy or puerperium.
- Painful eye with autonomic features.
- Post-traumatic onset of headache.
- Pathology of the immune system such as human immunodeficiency virus.
- Painkiller (analgesic) overuse (e.g., medication overuse headache) or new drug at onset of headache.

In the absence of any of the above red flags, conservative management is the evidence-based practice of choice.

2. True or false? Imaging is usually warranted for patients presenting with migraine headache.
- True.
  - False.

## ANSWER/DISCUSSION

2. **B.** According to an article by Walling,<sup>11</sup> serious conditions should be ruled out using patient history, the SNNOOP10 screening tool, a physical exam including neurological evaluation, and targeted imaging as indicated by findings from the history and physical. This article reaffirms that imaging is not recommended in the absence of red flags, or suspected trigeminal autonomic cephalgia, or other atypical headache. If an underlying disorder is suspected, specific imaging may be necessary to rule in/out this disorder. Personal and family history may be particularly helpful in identifying familial or other disorders that may be causing the patient's headache presentation.

Other more conservative assessments should be pursued prior to imaging in the absence of indicators. These assessments may include medication use evaluation to assess for any chronic medication overuse that could be triggering the patient's headache. Additionally, headache diaries can be helpful in identifying temporality and causation. Headache effects and impacts on quality of life are also helpful insights potentially gained from a headache diary.

3. In the nonemergent setting when both CT and MRI are available, what is the imaging modality of choice when evaluating a patient for headache with no allergies?
- CT with or without contrast.
  - MRI of the brain.
  - Both MRI and CT.
  - Imaging of choice is dependent upon clinical presentation and clinical setting.

## ANSWER/DISCUSSION

3. **B.** In the Choosing Wisely® campaign, several neurological recommendations have been made, including the American

College of Radiology recommendation to not perform imaging for uncomplicated headache.<sup>2</sup> The American Headache Society recommends not performing neuroimaging studies in patients with stable headaches that meet criteria for migraine and not performing CT for headache when MRI is available, except in emergency settings.<sup>3</sup> The American Academy of Neurology recommends not performing electroencephalography for headaches.<sup>1</sup>

Where available, MRI would be the nonemergent imaging modality of choice for evaluation of a headache that meets criteria.<sup>10</sup> If timely MRI is not available, or in an emergent evaluation setting, CT of the head can exclude intracranial hemorrhage or mass effects.

4. What is the 5-yr recurrence rate for seizures associated with CCMs?
- 10%.
  - 25%.
  - 60%.
  - 90%.

## ANSWER/DISCUSSION

4. **D.** Based on evidential data, patients with CCMs who present with hemorrhage have a 5-yr hemorrhage risk of at least 18%, higher initially, and potentially diminishing to about 5% annual risk at the 5-yr point. Risk of hemorrhage in incidentally identified solitary nonbrainstem CCMs is about 0.6% annually. However, this risk is increased with the presence of multiple lesions. The aviator's temporal lobe hemorrhage and surgery incur an increased risk for seizures, as do the presence of multiple subcortical cavernous malformations. It was not definitively concluded that the aviator's transient neurological episodes were seizures, but this is an additional potential aeromedical concern, as seizures associated with cerebral cavernous malformations carry a 5-yr recurrence rate of over 90%. Familial CCM patients also have a risk of developing future additional lesions, making serial clinical and radiological follow-up paramount.<sup>5,6</sup>

## AEROMEDICAL DISPOSITION

Your aviator was taken off flying status and his case was sent to the Aeromedical Consultation Service for review of multiple CCMs due to genetic predisposition and history of acute hemorrhage of one of the CCMs that required craniotomy for resection. Aeromedical concerns in this interesting case include effects of any baseline symptoms on flight safety, impact of any treatment regimens on flight safety, and the risk of future symptom development, with potential for operational distraction or incapacitation.

In this case, the aviator presented with subacute new-onset headaches. No concerning clinical findings were seen, but due to persistence and member concerns, cranial imaging was obtained showing a large left temporal hemorrhage and

multiple additional abnormalities that were eventually identified as cavernous malformations. These were located primarily supratentorially and in the cerebellar hemispheres, with no definitive brainstem involvement. The aviator had at least two episodes of transient neurological symptoms, one initially and the second 4 mo later with accompanying headache, which were suspicious for seizures. He underwent craniotomy for evacuation of the left temporal hemorrhage and did well post-surgically, except for persistent intermittent left-sided headaches that were managed with nonprescription medications.

The current frequency and intensity of headaches were not listed in the aviator's medical record. His father had a history of CCM with hemorrhage and the aviator tested positive for one familial CCM genetic marker. Follow-up cranial imaging showed no new abnormalities. Neuropsychological testing showed unremarkable findings. Current examination findings were noted as normal.

Unfortunately, the aviator's potential aeromedical risks associated with familial CCM<sup>5,6</sup> are deemed unacceptable for both U.S. Air Force flying class II and ground-based operator waiver<sup>8</sup> consideration. Therefore, for the familial CCM diagnosis, neither a flying class II nor a ground-based operator waiver is recommended. The Federal Aviation Administration,<sup>4</sup> Army,<sup>9</sup> and Navy standards<sup>7</sup> for intracranial lesions and vascular abnormalities have similar outcomes for this aviator. A sleep-deprived electroencephalogram study will be obtained locally and, if epileptiform changes are seen, reinstitution of antiepileptic medication will be strongly considered. The aviator will continue clinical and radiological follow-up as advised by his specialty consultants. He is advised to avoid activities that could potentially trigger seizures, such as prolonged sleep deprivation, binge ethanol intake, excessive stimulant intake, prolonged fasting or dehydration, and medications that list seizure as a significant adverse side effect.

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