

## Aerospace Medicine Clinic

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It is a normal-appearing morning, and you have been assigned to cover clinic today. Looking over the schedule, nothing appears to stand out, just the typical aches and pains as well as a “new headache ×3 d.” “Not too bad,” you think to yourself, but for the headache you pull up an online medical reference and review the recommendations for initial headache evaluation.

1. Which of the following mnemonics is useful to decide if imaging is needed at initial evaluation of a patient with new onset headache?
  - A. POUND.
  - B. CLUSTER.
  - C. SNNOOP10.

### ANSWER/DISCUSSION

1. C. The SNNOOP10 mnemonic [Systemic symptoms including fever, Neoplasm history, Neurological deficit (including altered consciousness), Onset (sudden or abrupt), Older age (especially after age 65), Pattern change or recent onset of new headache, Positional headache, Precipitated by sneezing, coughing, or exercise, Papilledema, Progressive headache and atypical presentation, Pregnancy or puerperium, Painful eye with autonomic features, Posttraumatic onset, Pathology of immune system (human immunodeficiency virus, etc.), and Painkiller overuse or new drug at onset] highlights 15 red flags across signs, symptoms, and history that are concerning for a secondary headache disorder.<sup>4</sup> The recommendation is for further evaluation, typically involving a head scan of some modality [either magnetic resonance imagery (MRI) or computed tomography (CT)]. In an epidemiological study of 1843 patients, only 12.9% had a secondary cause of their headaches, with medication overuse being the most common cause.<sup>2</sup> The POUND mnemonic (Pulsatile quality, duration 4–72 h, Ours, Unilateral location, Nausea/vomiting, Disabling intensity) is used for migraine headaches, while the CLUSTER mnemonic [Conjunctival injection (bloodshot eyes), Lacrimation, nasal congestion or rhinorrhea, forehead and facial sweating, miosis

or ptosis, Unilateral or ipsilateral, Severe or very severe unilateral orbital, supraorbital, or temporal pain lasting 15–180 min if untreated, Triptan injection works (oxygen and calcium channel blockers work, too), Eyelid drooping (ptosis) or eyelid swelling, and Restlessness or agitation] is used for cluster-type headaches.

A 27-yr-old remotely piloted aircraft (RPA) pilot who is right-hand dominant reports a 3-d history of headaches and denies previously having significant headaches or any headaches that have lasted this long. The headaches are described as a pressure-like sensation that is retro-orbital and unilateral. There is no family history of headache syndromes. Additionally, the member denies any improvement with acetaminophen or ibuprofen. Physical examination is normal without any focal neurological deficits.

Currently, you have yet to find anything that is concerning enough for imaging. However, you do perceive the member's spouse to be anxious appearing, so you attempt to ask a few more questions to hopefully alleviate concerns. Going back over red flag signs and symptoms in your mind, you ask if there are any changes to the headache with Valsalva- or vagal-type maneuvers. At this time, the member perks up and endorses that the headache changes from a dull aching quality to an intensified throbbing with increasing intra-abdominal pressure. Given the change in the nature of the headache, you decide to go ahead and order imaging. Now the question is, which type?

2. According to the 2019 American College of Radiologists Appropriateness Criteria, which of the following imaging modalities is considered “usually appropriate” for new headache onset with one or more red flags, one of which is change with activity or position?
  - A. CT head without intravenous (IV) contrast.
  - B. MRI head without IV contrast.
  - C. MRI head with and without IV contrast.
  - D. All the above.

**ANSWER/DISCUSSION**

2. **D.** According to the American College of Radiologists Appropriateness Criteria, all the choices are “usually appropriate” for initial imaging for a new onset headache with red flags. Those studies that are considered “usually not appropriate” include CT head with IV contrast, CT angiography head with IV contrast, magnetic resonance angiography head without IV contrast, and arteriography cervicocerebral.<sup>1</sup> However, the American Headache Society recommends that when neuroimaging for headache is indicated, MRI is preferred over CT, except in emergency settings when hemorrhage, acute stroke, or head trauma is suspected.<sup>7</sup> Thus, there is an argument to be made for B and C being correct, with A being reserved only for emergency circumstances.

You place the order for an MRI head without contrast. The study is performed the next day despite being ordered as routine. The next afternoon you are called by the radiologist who read the film. There is a 4.7- by 6.5-cm mass located in the right parietal lobe, median portion, that is accompanied by a 1-cm right-to-left midline shift. An urgent referral to Neurosurgery is placed and the member is informed in person the next day. As the first line of treatment, the member undergoes an initial subtotal surgical resection and biopsy, which confirms the diagnosis of a glioblastoma multiforme (GBM).

GBM is a severe and rapidly deteriorating neurological condition caused in part by a rapidly expanding mass effect. Prognosis is typically poor, with a median survival of 10–12 mo<sup>3</sup> with 1- and 5-yr survival rates at 38–50% and 5–10%, respectively.<sup>6</sup>

3. Which of the following symptoms is the most common presenting symptom for GBM?
  - A. Seizures.
  - B. Focal neurological symptoms such as visual changes or memory loss.
  - C. Headache.

**ANSWER/DISCUSSION**

3. **C.** Up to 50–60% of patients with GBM have headaches as the presenting symptom,<sup>2</sup> with those headaches typically being a dull, constant, tension-type headache (40–80%).<sup>2</sup> Seizures are present in 20–50% of patients, while focal neurological symptoms are the least common, presenting first in about 10–40% of patients.<sup>2</sup>

4. Which of the following factors influences survival time for GBM patients?
  - A. O6-methylguanine-DNA-methyltransferase methylation status.
  - B. History of preexisting neurological disorder.
  - C. History of smoking.

**ANSWER/DISCUSSION**

4. **A.** According to Zhao et al., an 11-study review showed that a positive methylation status conveyed an improved overall and progression-free survival rate.<sup>13</sup> While history of preexisting conditions and smoking status could certainly impact overall morbidity, there was no study reviewed that discussed either of these as independent factors for survival time. In this instance, the aviator did have a positive methylation status.

5. Aeromedical concerns for a GBM, let alone any type of cancer, may include which of the following?
  - A. Recurrence.
  - B. Sudden incapacitation.
  - C. Side effects of surgery, radiation, and/or chemotherapy.
  - D. Residual tumor (subtotal resection).
  - E. All the above.

**ANSWER/DISCUSSION**

5. **E.** All the answer choices are listed in the U.S. Air Force Aerospace Medicine Waiver Guide<sup>12</sup> as being aeromedical concerns for affected members returning to flight. Any members returned to flight must be able to endure the rigors of the aviation environment as well as retain the ability to safely egress the aircraft. Certain circumstances may require the member to undergo further centrifuge and/or altitude chamber training prior to waiver consideration.

The Federal Aviation Administration (FAA) and service components of the Department of Defense address malignancies in aviators. The FAA requires an FAA decision; thus, the Aviation Medical Examiner must defer certification.<sup>5</sup> In correspondence with the FAA Aerospace Medical Certification Division, since 2013 there was one applicant with a diagnosis of GBM who was denied certification. However, there have been special issuances granted for low-grade gliomas with demonstrated stability after 5yr. Follow-up may require an annual MRI for first- or second-class applicants. For malignancies at large, there are no Conditions an Aviation Medical Examiner Can Issue. The Air Force classifies RPA pilots as ground-based operators. For this service, GBM is disqualifying under three separate lines of the Medical Standards Directory: O1, malignant neoplasm; L33, history of diagnostic or therapeutic craniotomy; and L35, intracranial malignant neoplasm.<sup>9,10</sup> To qualify for a waiver, the important factors are that the malignancy must be considered cured, the member must be off all chemotherapeutic agents long enough to allow for all intended and unintended effects to have resolved, and there must not be any significant side effects from any of the treatments (including radiation necrosis and other issues from radiation therapy). The Army lists RPA pilots as Class 4 and any neurological tumor requires suspension.<sup>11</sup> Finally, in the Navy, RPA pilots are Class IV and these tumors are considered disqualifying with no waiver recommended.<sup>8</sup>

In this instance, early imaging in the work-up process was key to the diagnosis and expediting treatment of this condition. In this case, the member did not pursue a service-specific waiver nor an FAA Special Issuance.

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## REFERENCES

1. American College of Radiology. ACR Appropriateness Criteria®: headache. 2022. [Accessed 1 Nov. 2022]. Available from <https://acsearch.acr.org/docs/69482/Narrative/>.
2. Chang SM, Parney IF, Huang W, Anderson FA Jr, Asher AL, et al. Patterns of care for adults with newly diagnosed malignant glioma. *JAMA.* 2005; 293(5):557–564.
3. Chien LN, Gittleman H, Ostrom QT, Hung KS, Sloan AE, et al. Comparative brain and central nervous system tumor incidence and survival between the United States and Taiwan based on population-based registry. *Front Public Health.* 2016; 4:151.
4. Do TP, Remmers A, Schytz HW, Schankin C, Nelson SE, et al. Red and orange flags for secondary headaches in clinical practice: SNNOOP10 list. *Neurology.* 2019; 92(3):134–144.
5. Federal Aviation Administration. Item 46. Neurologic. III. Aerospace medical disposition. Cerebrovascular disease. Brain tumor (intracranial tumor). In: Guide for aviation medical examiners. Washington (DC): Federal Aviation Administration; 2023:166–168. [Accessed 31 Jan. 2023]. Available from [https://www.faa.gov/about/office\\_org/headquarters\\_offices/avs/offices/aam/ame/guide/media/Brain-Tumors.pdf](https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/media/Brain-Tumors.pdf).
6. Korja M, Raj R, Seppä K, Luostarinen T, Malila N, et al. Glioblastoma survival is improving despite increasing incidence rates: a nationwide study between 2000 and 2013 in Finland. *Neuro-oncol.* 2019; 21(3): 370–379.
7. Loder E, Weizenbaum E, Frishberg B, Silberstein S; American Headache Society Choosing Wisely Task Force. Choosing wisely in headache medicine: the American Headache Society's list of five things physicians and patients should question. *Headache.* 2013; 53(10): 1651–1659.
8. Naval Aerospace Medical Institute. 9.13 Neurological tumors. In: U.S. Navy aeromedical reference and waiver guide. Pensacola (FL): Naval Aerospace Medical Institute; 2022. [Accessed 27 March 2022]. Available from <https://www.med.navy.mil/Naval-Medicine-Operational-Training-Command/Naval-Aerospace-Medical-Institute/Aeromedical-Reference-and-Waiver-Guide/>.
9. U.S. Air Force. Section L: neurologic. USAF medical standards, L33, L35. In: Medical standards directory; 2021:48. [Accessed 21 Feb. 2022]. Available from <https://afspecialwarfare.com/files/MSD%2019%20Mar%202021.pdf>.
10. U.S. Air Force. Section O: tumors and malignancies. USAF medical standards, O1. In: Medical standards directory; 2021:55. [Accessed 21 Feb. 2022]. Available from <https://afspecialwarfare.com/files/MSD%2019%20Mar%202021.pdf>.
11. U.S. Army Aeromedical Activity. Neurological tumors. In: Flight surgeon's aeromedical checklists. Aeromedical policy letters. Ft. Rucker (AL): U.S. Army Aeromedical Activity; 2014. [Accessed 21 Feb. 2022]. Available from <https://docplayer.net/5184761-Aeromedical-checklists.html>.
12. Van Syoc D. Cancers (misc.) (Jan 2016). In: Aerospace medicine waiver guide. Wright-Patterson AFB (OH): U.S. Air Force School of Aerospace Medicine; 2023. [Accessed 24 Jan. 2023]. Available from <https://www.af.mil/711HPW/USAFSAM/>.
13. Zhao H, Wang S, Song C, Zha Y, Li L. The prognostic value of MGMT promoter status by pyrosequencing assay for glioblastoma patients' survival: a meta-analysis. *World J Surg Oncol.* 2016; 14(1):261.

## Erratum

Lerner D, Pohlen M, Wang A, Walter J, Cairnie M, Gifford S. *X-ray imaging in the simulated microgravity environment of parabolic flight.* *Aerosp Med Hum Perform.* 2023; 94(10):786–791.

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In the above article, the authors stated their study was the first to perform radiographs in microgravity. However, this is incorrect as X-rays were taken in the 1970s in parabolic flight in an attempt to understand the effects of microgravity on lung shape. The authors and the journal apologize for this misstatement.