Aerospace Medicine Clinic

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You are a military flight surgeon assigned to a small military aid station. Reviewing your list of patients for the day, you see that you have a return to duty evaluation for a prospective pilot student who was seen by a local emergency department. As you head to meet the patient, your medic brings a discharge summary from the emergency department. The pilot student was in a single vehicle motorcycle accident over the weekend, and, with a quick glance at the emergency department records, the injuries to the patient appear to be negligible. He was traveling at low speed and the small motorcycle slipped from underneath him while making a turn. It looks like he suffered only minor abrasions to one of his legs.

As you head into the examination room, you introduce yourself to a 26-yr-old healthy-appearing male service member in no apparent distress. He is wearing shorts and a t-shirt, and you can see some mild abrasions on the outside of his left leg. As you discuss his accident, you find out that he was wearing appropriate protective clothing, including a helmet. Further discussion reveals that he had continued the short trip home to clean himself up when a friend noticed that his helmet had some minor scrape marks. Although his only complaint was a "sore leg," his friend was concerned for a possible head injury. Out of an abundance of caution, the service member stated he consented to "get checked out" at the local emergency room, where he received a "CAT scan" of his head and "the docs didn't see any problems."

The physical examination reveals no concerning injuries or dysfunction, and the superficial abrasions are crusted over, healing appropriately, and have no sign of infection. Before you approve the return to duty, which will include starting his first day of aviation training in 3 wk, you take a closer look at his discharge paperwork. The report from the CT scan showed no intracranial abnormalities related to the accident, but there was an incidental finding in the "foramen of Monro." Being a little rusty on your intracranial anatomy, you look up this anatomical structure.

1. What is the foramen (or foramina) of Monro?
   A. An opening of the fourth ventricle at the caudal portion of the roof of the fourth ventricle.
   B. A pair of small openings that connect the lateral ventricles of the brain to the third ventricle.
   C. Small zones lying between the costal and sternal attachments of the thoracic diaphragm.
   D. Foramina in the ventricular system linking the fourth ventricle to the cerebellopontine cistern.

ANSWER/DISCUSSION

1. B. The foramina of Monro are passages between the lateral ventricles of the brain and the third ventricle that allow for circulation of cerebral spinal fluid (CSF).[1] Colloid cysts are most likely to form in the vicinity of this foramen.[2] The foramen of Magendie (a.k.a. the median aperture) connects the CSF-filled spaces of the fourth ventricle and the cisterna magna (a.k.a. the cerebellomedullary cistern).[1] A failure of this foramen to form during gestation can cause a cystic obstruction.[3] The sternocostal triangle (a.k.a. foramina of Morgagni, Larrey's space, sternocostal hiatus, among other names) consists of two zones covered by connective tissue that allow for passage of the bilateral internal thoracic vessels through the anterior abdominal wall. These structures can be a weak point leading to retrosternal hernia.[4] The foramen of Luschka is superior to the foramen of Magendie and presents bilaterally.[1] The foramen of Luschka leads to the cerebellopontine cistern (a.k.a. the pontocerebellar cistern), which is a common site for tumors arising from neurological tissue.[5]

The radiologist elaborates on the incidental finding and states that it is a "sub-centimeter hyperattenuating focus within the foramen of Monro, likely a benign colloid cyst." It is approximately 5 mm in size. Furthermore, the radiologist recommends an MRI of the brain for further evaluation. From your studies, you remember that a colloid cyst is a tumor in the brain that consists of gelatinous material covered by a membrane of epithelial tissue.

DOI: https://doi.org/10.3357/AMHP.6437.2024

2. Can colloid cysts be a danger to safety in flight?
   A. Yes. Colloid cysts are most often found in the foramen of Monro and can block the flow of CSF.
   B. Yes. They are malignant and very likely to metastasize.
   C. No. They pose little danger as they always remain at an inconsequential size and are only incidental findings.
   D. No. Along with C, they have a good chance of regressing and generally remain insignificant clinically.

ANSWER/DISCUSSION

2. A. As in this case, colloid cysts are most often found incidentally, are asymptomatic, and are commonly positioned in the roof of the third ventricle adjacent to the foramina of Monro. This can occasionally result in sudden obstructive hydrocephalus. It can also present with a thunderclap headache and the dreaded (especially in aviation circles) unconscious collapse. The remaining answers are not accurate. Colloid cysts can cause severe symptoms, as noted above. However, they are benign and can demonstrate slow growth or, more commonly, stability over time (particularly with small asymptomatic lesions), with low recurrence after complete resection.[2,6] While colloid cysts are often an incidental finding, they can cause a range of neurological symptoms secondary to hydrocephalus due to blocking the foramen of Monro. Rapid growth of colloid cysts leading to acute hydrocephalus has been lethal in some cases (such as cyst apoplexy, which is very rare).[7,8] As stated previously, colloid cysts do have the ability to grow over time, although 90% show benign stability and they generally do not regress.

You discuss your concerns with the patient. Unfortunately, you must break the news to him that this incidental finding needs to be worked up before you can agree to return him to duty. You check again to make sure he has no headache or neurologic signs or symptoms. Finding none, you tell the patient that you are going to set up an MRI of the brain. This will be done with and without gadolinium contrast to address a differential diagnosis, including ependymoma, subependymoma, craniopharyngioma, meningioma, choroid plexus papilloma/carcinoma, and neurocysticercosis, to help confirm the identity of the incidental finding and provide data for the appropriate specialists to work on the way ahead. You also state that you will be doing some homework to learn more about colloid cysts and look up how this may affect his flight status.

3. Which of the following is false about colloid cysts?
   A. They comprise up to 17% of primary brain tumors.
   B. They comprise approximately 15–20% of intraventricular masses.
   C. The majority of cases are diagnosed in patients between 20–50 yr of age.
   D. They can contain mucin, hemosiderin, cholesterol, and various ions, giving them a wide range of imaging appearance.

ANSWER/DISCUSSION

3. A. Colloid cysts comprise less than 2% of primary brain tumors. The incidence of colloid cysts of the third ventricle is approximately 0.9 per 1 million, and the prevalence is estimated to be around 1 in several thousand.[9] However, colloid cysts account for approximately 20% of intraventricular primary brain tumors.[2] Most patients are diagnosed with a colloid cyst between the third and fifth decades, but they can also be seen in infancy and childhood.[10] Additionally, they can contain mucin, hemosiderin, cholesterol, and various ions, giving them a wide range of imaging appearance.[11]

As you investigate the subject further, you find that MRI is generally the best modality to confirm the identity of a colloid cyst. As a CT is not as reliable for this task, you see that the radiologist's suggestion for an MRI (with and without gadolinium) will be essential to the workup.

4. Which of the following could be mistaken for a colloid cyst?
   A. Craniopharyngioma.
   B. Pilocytic astrocytoma.
   C. Meningioma.
   D. Hematoma.
   E. All of the above.

ANSWER/DISCUSSION

4. E. All of the above lesions can appear similar to a colloid cyst on imaging.[2]

Concerned that this student pilot's career may be over before it starts, you delve into the aeromedical policies of his service and the sister organizations (International Civil Aviation Organization [ICAO], Federal Aviation Administration [FAA], U.S. Navy, U.S. Army, and U.S. Air Force) for guidance on his possible disposition. Upon reviewing the literature, ICAO is the only one of the five organizations that explicitly mentions colloid cysts. While neither the FAA, U.S. Navy, U.S. Army, nor U.S. Air Force specifically make a statement about colloid cysts with regard to returning to flight duties, they do discuss various benign and malignant tumor policies that may be applicable to this case.

The ICAO Manual of Civil Aviation Medicine, Section 10.5 discusses neurologic neoplasms. It states: "Benign parenchymal growths include ependymoma, choroid plexus papilloma, and colloid cyst (considered a cyst rather than a neoplasm) … The presence of a benign intracranial neoplasm is disqualifying for all classes of medical certification."[12] However, medical certification may be considered after 1 yr of observation if the benign neoplasm is removed and recovery is uncomplicated.[12]

From the FAA standpoint, a special issuance would be needed for medical clearance. The benign brain tumor subsection of Item 46. Neurologic of the Guide for Aviation Medical Examiners would be most applicable. Disposition concerning medical clearance would require deferment for FAA decision. For benign brain tumors not surgically treated, the FAA would

require that the examiner submit all pertinent medical records, current neurologic evaluation, MRI brain scans performed no more than 12 mo before the AME exam, and the name, dosage, and side effects of medication(s). If the lesion is surgically treated or resected, in addition to the previous requirements, a neuropsychological evaluation and a 2-yr waiting period will be required.[13]

According to the U.S. Navy Aeromedical Reference and Waiver Guide's section on neurological tumors, "all tumors involving the brain or meninges, irrespective of therapeutic outcome, are [considered disqualifying] with no waiver recommended."[14] The U.S. Army has a similar policy in that "all tumors involving the brain or meninges, irrespective of therapeutic outcome, are permanently disqualifying in class 2, 3 or 4 applicants and require aeromedical suspension in trained aircrew."[15]

The U.S. Air Force has removed the topic of malignant neurological tumors from its waiver guide due to the paucity of waiver submissions and has no mention of the disposition of benign lesions. However, regarding the disposition of cancers in general, the waiver request should only be submitted after "clinical disposition has been completed and all appropriate treatments have been initiated using best current clinical guidelines and recommendations."[16] The Air Force has a 6-mo stability period requirement following cessation of definitive therapies.[16]

Results of the patient's MRI show a well-delineated hyperintensity on T1, with peripheral rim enhancement after the administration of gadolinium, and isointensity on T2 weighted images, confirming the diagnosis of a colloid cyst. There is an absence of ventriculomegaly. As noted by Khanpara et al., "third ventricular colloid cysts are well known for their potential to become symptomatic by creating ventricular obstruction often with serious outcome [through a ball valve effect]."[17] Consultation with an aviation neurologist and a neurosurgeon, taken in context with the service member's applicable aviation medicine regulations, leads to the recommendation of a waiver for this incidental finding. A 5-mm incidental, asymptomatic colloid cyst would have a low likelihood of either radiographic progression or acute/subacute neurologic decline. The neurosurgeon counsels that the chance of 10-yr radiographic progression is 10%, with clinical progression near 0%, for this small (5-mm) asymptomatic lesion without ventriculomegaly.

Of note, his service is amenable to retaining the individual and gives him the option to retrain in a nonaviation position. However, the patient entered the service with the express purpose of becoming a pilot. He requests that you go forward with the waiver application. Along with examinations by a neurologist and neurosurgeon, the waiver workup includes a cognitive baseline assessment to assist with monitoring his condition. Happily, for all involved, his service grants the waiver and requires him to have yearly follow-ups that include a CT or MRI for the next 3 yr.

Pavelites JJ II, Newsome JK, Pavelites JJ. ***Aerospace medicine clinic: colloid cyst.*** **Aerosp Med Hum Perform. 2024; 95(5):282–285.**

ACKNOWLEDGMENTS

The authors would like to thank Dr. Paul Porensky for his review of the manuscript prior to submission. The views expressed are those of the authors and do not reflect the official guidance or position of the U.S. Government, the Department of Defense (DoD), or the U.S. Army. The appearance of external hyperlinks does not constitute endorsement by the DoD of the linked websites, or the information, products, or services contained therein. The DoD does not exercise any editorial, security, or other control over the information you may find at these locations.

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