Subarachnoid Mirage: A Case of Pseudosubarachnoid Hemorrhage

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A 22-year-old man with a history of intravenous methamphetamine use presented with severe headache for 5 days, was afebrile, and had nuchal rigidity. Computed tomography and magnetic resonance imaging results were interpreted as revealing acute subarachnoid hemorrhage. Twenty-four hours later, he developed acute neurologic deterioration. A lumbar puncture was performed, revealing the presence of *Staphylococcus aureus*. The false-positive image mimicking blood was potentially a result of an extremely high protein concentration present in the cerebrospinal fluid, provoked by an intense inflammatory reaction leading to disruption of the blood-brain barrier. Pyogenic meningitis is one of the causes of pseudosubarachnoid hemorrhage, or a false diagnosis of subarachnoid hemorrhage, when one does not actually exist. [Ann Emerg Med. 2019;73:130-132.]

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INTRODUCTION

Headache is a common chief complaint in the emergency department (ED); in fact, it was the fourth most common chief complaint in ED presentations.[1] Unfortunately, it is often difficult for emergency physicians to differentiate the possible life-threatening causes from the benign.[2] As a result, emergency physicians often rely on diagnostic studies, including computed tomography (CT), magnetic resonance imaging (MRI), and lumbar puncture, to rule out significant causes of headache.

In medicine, as in nature, sometimes the eye can trick the mind. Occasionally, we cannot believe what we see; medical mirages that show something that does not exist need to be considered in our differential.

CASE REPORT

A 22-year-old man with a history of intravenous methamphetamine drug use presented with severe headache for 5 days before presentation. He had severe photophobia, nausea and vomiting, and nuchal rigidity. He was afebrile by rectal thermometer and denied any previous fever. The patient denied any trauma, but did admit to recent methamphetamine use. With the exception of left facial numbness, he had an intact neurologic examination result. He had a CBC count, with a WBC count of $4.4\times10^3/mm^3$.

CT was performed (Figure 1), and the result was interpreted as acute subdural hemorrhage along the inferior right tentorial leaflet and acute subarachnoid hemorrhage of the right brainstem. Radiology suggested that it might have been related to an aneurysm or vascular malformation. Emergency neurosurgery consultation was requested and the patient was promptly admitted and transferred to the neurosurgical ICU. A CT angiogram was performed, which showed no mass, aneurysm, vascular malformation, dissection, or occlusion. There was irregularity of the right posterior inferior cerebellar artery and right anterior inferior cerebellar artery, thought to potentially represent vasospasm. A stable subarachnoid hemorrhage along the right cerebellopontine angle and internal auditory canal, and subdural hemorrhage along the right tentorium were observed.

Subsequent MRI was obtained within the first 24 hours, and the result was also interpreted as acute subarachnoid hemorrhage (Figure 2).

The following day, the patient became febrile and had a declining mental status. Lumbar puncture revealed an elevated opening pressure of 48 mm Hg and cloudy cerebrospinal fluid. The laboratory analysis revealed xanthochromic fluid, a glucose level of less than 10 mg/dL, protein level of 846 mg/dL, and a nucleated cell count of $21.500\times10^9/L$, with 96% segmented neutrophils. The Gram's stain revealed Gram-positive cocci that eventually grew methicillin-sensitive *Staphylococcus aureus* in the cerebrospinal fluid culture. The patient's hospital course followed with intravenous antibiotics administration, mechanical ventilation, and intracranial pressure monitoring requirement because of severe hydrocephalus. An echocardiogram did not reveal vegetations and

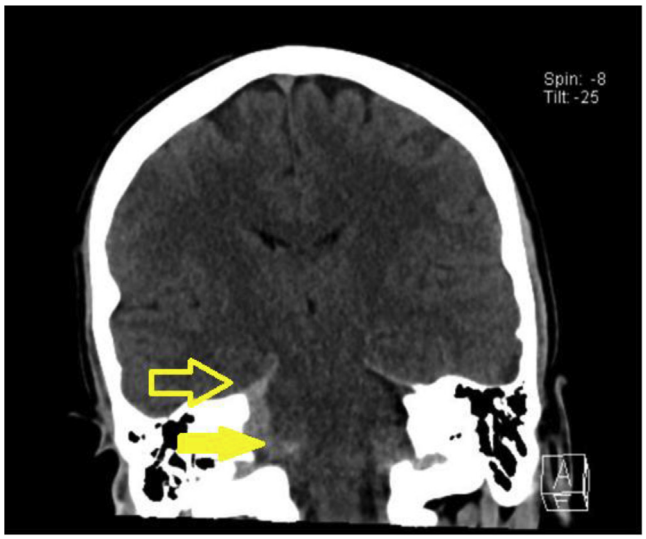

Figure 1. Noncontrast brain CT with hyperdense material along the inferior right tentorial leaflet and right brainstem. The hollow arrow was read as subdural hemorrhage and the solid arrow was read as subarachnoid hemorrhage.

blood cultures did not yield bacterial growth. The patient's clinical status improved and he was discharged home with no neurologic sequelae.

The diagnosis was pseudosubarachnoid hemorrhage and methicillin-sensitive *Staphylococcus aureus* meningitis.

DISCUSSION

Subarachnoid hemorrhage and meningitis are considered top differential diagnoses in patients with headache and nuchal rigidity. Methamphetamine users have an estimated increased risk of hemorrhagic stroke, at 2 to 5 times that of controls,[3] thought to be the result of drug-induced hypertensive surges, tachycardia, and a direct effect on the vessel wall that can promote vasculitis, damage, and rupture.[3,4] Illicit intravenous drug use also poses a higher risk of systemic infections that could affect the central nervous system directly or by emboli of a septic source.

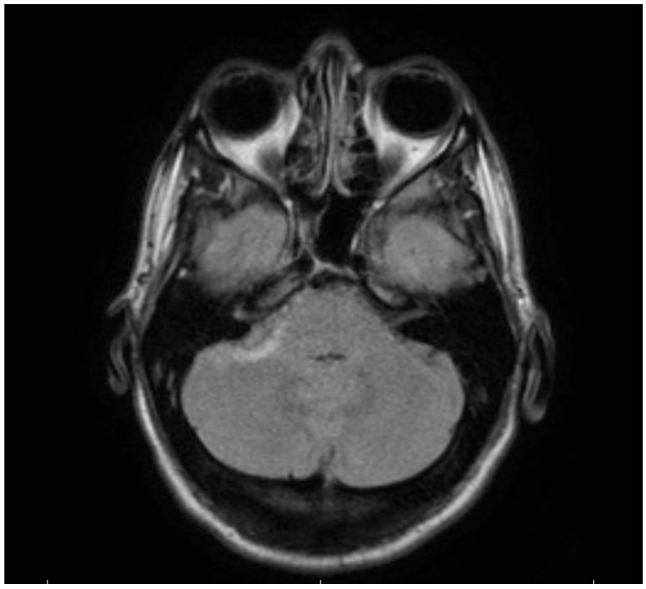

Figure 2. MRI brain T2-weighted image, demonstrating increased signal along the inferior right tentorial leaflet and brainstem.

We present a case of a patient without a fever or elevated WBC count who had central nervous system images that showed the apparent presence of blood in the subarachnoid space; in fact, these images represented inflammatory fluid content with radiographic characteristics similar to those of blood. It has been reported in the literature that meningitis, either bacterial or fungal, can mimic subarachnoid hemorrhage.

Chatterjee et al[5] presented a case of a presumed subarachnoid bleeding event in an anticoagulated woman, in which MRI and CT results were also interpreted as subarachnoid hemorrhage, but subsequent diagnosis by lumbar puncture revealed bacterial meningitis. Hoque et al[6] published a report of a patient with a brain abscess as a result of *Cryptococcus neoformans* that presented similarly, and most recently Lang et al[7] reported in the European emergency medicine literature a febrile patient with an incorrect diagnosis of subarachnoid hemorrhage in neuroimaging.

Knowledge of the radiographic mimics of subarachnoid hemorrhage might have changed this patient's course, possibly resulting in both earlier diagnosis and treatment. Several radiographic mimics exist in addition to purulent meningitis. These include cerebral infarction, subdural hematoma, leakage of intravenous contrast into the subarachnoid space, status epilepticus, intracranial hypotension, intrathecal administration of contrast medium, polycythemia vera, and diffuse cerebral edema because of a variety of causes, including central nervous system hypoxia.[8]

Several mechanisms have been proposed for this phenomenon. In meningitis, it has been suggested that inflammatory infiltrates in the subarachnoid space and cerebrospinal fluid may compromise the basal cistern and disrupt the blood-brain barrier. This inflammatory process may lead to the leakage of protein-rich fluid into the basal cisterns and subarachnoid spaces, which would account for the hyperdensity observed in pseudosubarachnoid hemorrhage.[5-9] With severe infection and sufficient protein accumulation, cerebrospinal fluid attenuation is increased, giving the false appearance of subarachnoid hemorrhage on CT. Likewise, on MRI, protein concentration causes hyperintense cerebrospinal fluid on fluid-attenuated inversion recovery, mimicking subarachnoid hemorrhage.[10]

The classic triad for bacterial meningitis consists of fever, nuchal rigidity, and change in mental status. Nevertheless, this triad may be absent in up to 50% of patients with meningitis[11]; this is a rare presentation of pseudosubarachnoid hemorrhage caused by meningitis, in which the patient presented afebrile and with a normal neurologic examination result.

This case report, in addition to others, reminds emergency physicians to keep their differential broad and be highly wary of false-positive results on imaging studies. In patients who present with a headache and nuchal rigidity but an otherwise inconsistent clinical picture, even a "CT-confirmed" subarachnoid hemorrhage does not rule out the possibility of meningitis.

As a final reflection on the lessons of this case report, a mirage, in contrast to a hallucination, is a real optical phenomenon that can be captured on camera (or on CT).

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IMAGES IN EMERGENCY MEDICINE

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DIAGNOSIS:

Embolization of prosthetic aortic valve. Valve embolization is rare and typically observed as a complication of transcatheter aortic valve replacement. This generally occurs periprocedurally[1] and mandates immediate removal of the displaced valve.

The patient lost pulses in his lower extremities and was expeditiously taken to the vascular suite for endoscopic valve retrieval but deteriorated and ultimately experienced cardiac arrest.

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