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## Xanthochromia Is Not Pathognomonic for Subarachnoid Hemorrhage

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**Introduction:** Most patients with subarachnoid hemorrhage (SAH) can be diagnosed with computed tomography (CT), but a lumbar puncture is required to exclude SAH. The presence of cerebrospinal fluid xanthochromia within several hours of symptom onset suggests SAH and is considered to distinguish SAH from a traumatic spinal tap. An in vitro observational study examined the hypothesis that xanthochromia, the yellow discoloration of cerebrospinal fluid caused by hemoglobin catabolism, may be seen as well in traumatic lumbar puncture.

**Methods:** A model of traumatic lumbar puncture was developed by adding whole blood to pigment-free cerebrospinal fluid to obtain RBC concentrations of 0, 5,000, 10,000, 20,000, 30,000, and 40,000 RBC/ $\mu$ L. Samples were centrifuged and the supernatant analyzed by spectrophotometry, measuring absorbance from 400 to 700 nm immediately and at hourly intervals after the initial mixing of RBC and cerebrospinal fluid. Xanthochromia was considered present on the basis of values obtained in previous studies. Before this study, additional experiments were conducted to ensure that its methods did not cause xanthochromia.

**Results:** Xanthochromia was detected immediately in samples with at least 30,000 RBC/ $\mu$ L, at 1 hour in samples with 20,000 RBC/ $\mu$ L, and within 2 hours in samples with 10,000 RBC/ $\mu$ L or less. Four hours elapsed before all samples

containing 5,000 RBC/ $\mu$ L became positive. No spectrophotometric evidence of xanthochromia was noted in cerebrospinal fluid controls.

**Conclusion:** In this model, cerebrospinal fluid xanthochromia could be seen within 2 hours after traumatic lumbar puncture and even sooner in samples with greater than 10,000 RBC/ $\mu$ L. Clinicians should be aware that xanthochromia unrelated to SAH may be detected in traumatic lumbar punctures with a high RBC count. When the time between sample acquisition and analysis is delayed or the cerebrospinal fluid RBC count is elevated above 10,000 RBC/ $\mu$ L, xanthochromia should not be relied on to confirm a diagnosis of SAH.

**Comment:** "If there is xanthochromia present, it must be a subarachnoid hemorrhage" is a bromide that has existed for a long time. Never say never in medicine, and the authors show us why. Even samples with 5,000 cells/ $\mu$ L showed a significant level of xanthochromia at 2 hours. I know your lab never tests samples that long after they have been obtained, but it sometimes happens around my shop, and it is quite useful to be aware of these data.

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**Comment:** Graves and Sidman use a clever model to demonstrate that cerebrospinal fluid xanthochromia may be noted very quickly in traumatic lumbar punctures containing 10,000 RBC/ $\mu$ L or more. Although they would like us to use these data to prevent unnecessary testing and admission for CT-negative patients in whom a subarachnoid hemorrhage is being considered, I'm not sure many emergency physicians will have the nerve to discharge a patient with a severe headache/suspected subarachnoid hemorrhage and xanthochromic spinal fluid even if the tap was traumatic. The consequences for a mistake on this one are too great.

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### IMAGES IN EMERGENCY MEDICINE (continued from p. 545)

#### Diagnosis:

A noncontrast head computed tomography (CT) scan showed slight narrowing of the ventricles and mild left-sided edema. A magnetic resonance imaging scan revealed a cavernous sinus thrombosis (Figure 2). The patient was admitted and treated with intravenous antibiotics and heparin. Magnetic resonance imaging with gadolinium is the diagnostic test of choice for detection of cerebral venous thrombosis because thrombi can be visualized. CT scans are often abnormal but nonspecific. The most common CT findings are small ventricles and edema; results of CT scans are abnormal but nonspecific in up to 80% of patients.