Traumatic Subarachnoid Hemorrhage (tSAH)
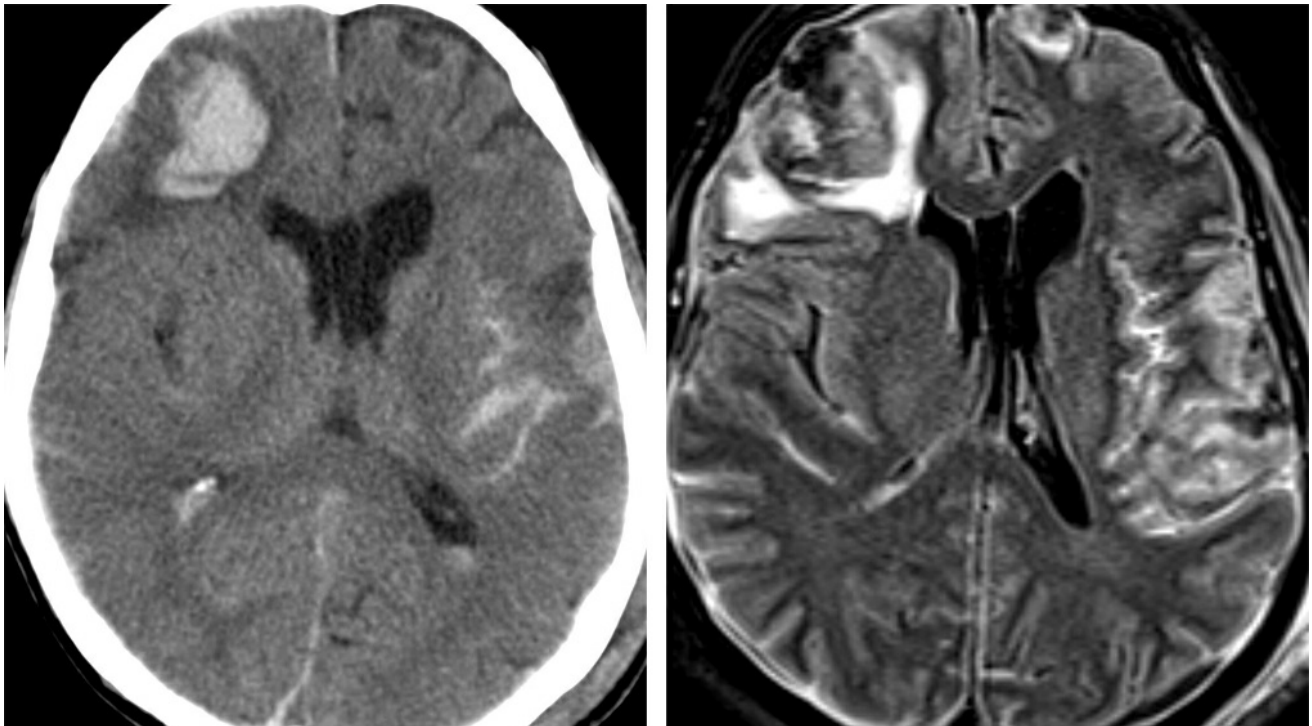
Last Updated: March 13, 2020

Figure 1: CT (left) and FLAIR MRI (right) images demonstrate a number of findings in this post-traumatic patient. Subarachnoid blood in the sulci is most pronounced in the left Sylvian fissure as dense on CT and hyperintense on FLAIR. In fact, the FLAIR is often more sensitive for detection of subarachnoid hemorrhage unless in the basal cisterns. Intraventricular blood is also present. The CT-hyperdense, FLAIR-heterogeneous hematoma in the right frontal lobe represents a hemorrhagic contusion. The surrounding edema is hypodense on CT and hyperintense on FLAIR, as expected. Thin subdural hematomas are more

clearly visible on FLAIR surrounding the right cerebral hemisphere and posterior to the left cerebral hemisphere, but can also be seen as a hyperdense collection anterior to the right frontal lobe on CT.
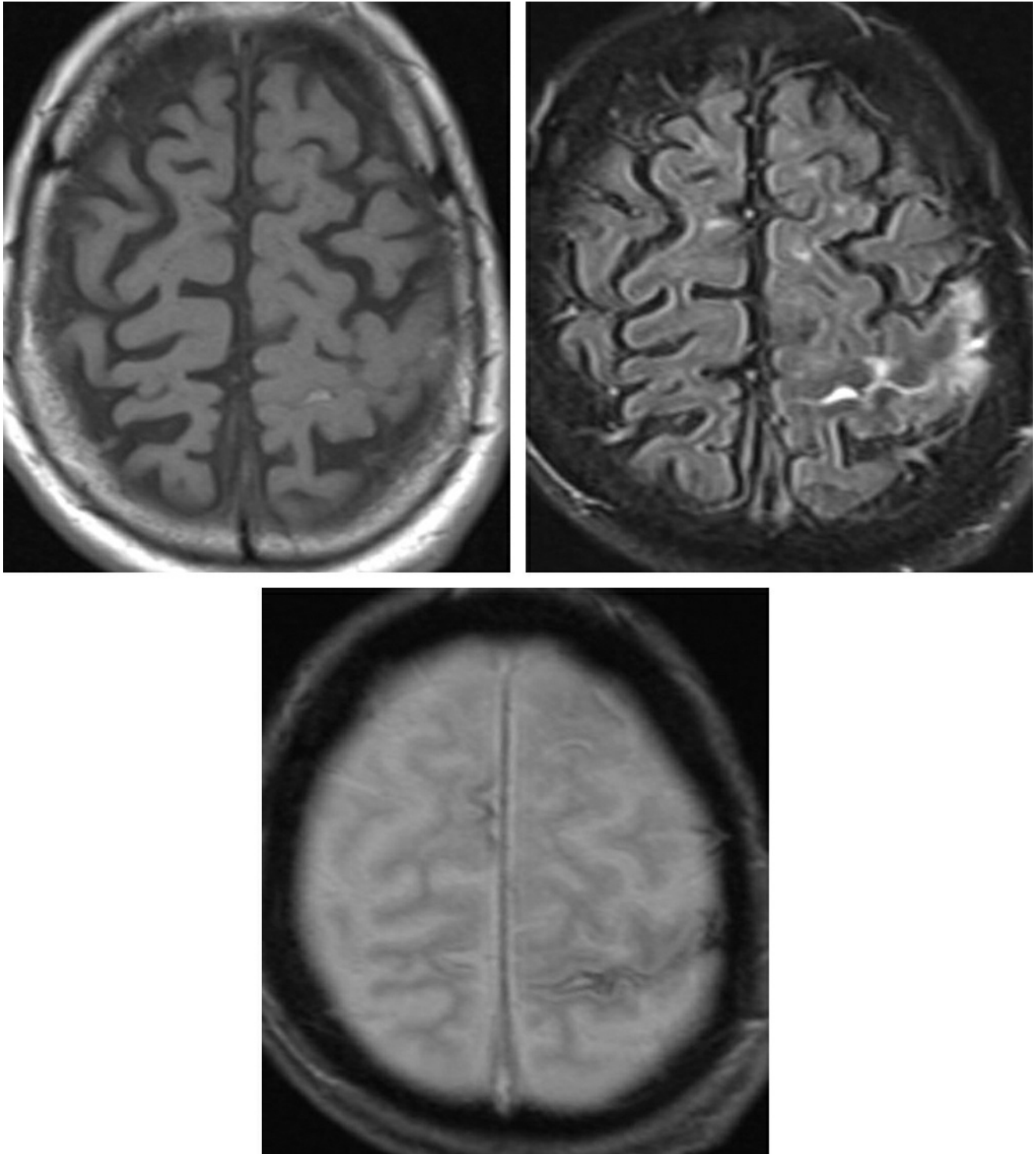

Figure 2: Early chronic subarachnoid hemorrhage is more difficult to see on this T1-weighted image as hyperintensity with a sulcus (top row left) but is much more conspicuous as

hyperintensity in the same region on FLAIR (top row right). Low signal intensity hemosiderin deposition is present on this GRE image along the cortex (bottom row).

- Hemorrhagic collection within the subarachnoid space, located between pia and arachnoid membranes.

- Hunt and Hess scale: describes 5 grades of the severity of subarachnoid hemorrhage based on clinical correlates and is used to predict survival

- Fisher scale: a CT-based classification of subarachnoid hemorrhage into four groups based on the amount of blood, and is useful in predicting cerebral vasospasm

- World Federation of Neurosurgical Societies (WFNS) is a grading system for the severity of subarachnoid hemorrhage, based on Glasgow Coma Scale and presence of focal neurological deficits. Conscious state is used as a predictor of mortality and neurological deficits like hemiparesis or aphasia as a predictor of morbidity. ([Radiopaedia](https://radiopaedia.org))

- Location
    - Focal
        - Isolated to convexity sulci adjacent to contusion, subdural/epidural hematoma, fracture/laceration
    - Diffuse
        - Spread diffusely within the subarachnoid spaces and the basal cisterns

- May show layering on tentorium

Neuroimaging

- CT Findings
  - CT without contrast
    - Best imaging tool
    - Hyperattenuation in the subarachnoid spaces and cisterns (See Figure 1)
    - Hyperattenuation within the interpeduncular cistern may be the only sign of a subtle tSAH (For additional images reference the Epidural Hematoma chapter)
  - CT with contrast
    - Should not be used to identify tSAH as contrast enhancement of cortical veins will obscure subarachnoid blood
- MRI Findings
  - T1WI: sometimes hyperintense to ventricular CSF
  - T2WI: Isointense to CSF, not usually detectable
  - FLAIR:
    - Very sensitive for detecting subtle tSAH
    - SAH detected as hyperintense signal relative to CSF (See Figure 1)
  - T2*/GRE/SWI: Occasionally hypointense (See Figure 2)
  - DWI: May see restricted diffusion in acute SAH (but not chronic) due to areas of ischemia from

SAH induced vasospasm

- Angiographic Findings
  - Can evaluate tSAH-induced vasospasm, which presents as beaded vessels noted during a window of 2 days to 2 weeks
  - Digital subtraction angiography is the gold standard to exclude aneurysm, arterio-venous malformation, dural arterio-venous fistula
  - However, unless planning a surgical intervention, this has been largely superseded by CT angiography due to the risk profile of angiography
- Differential Diagnosis for traumatic subarachnoid hematoma
  - Non-traumatic SAH
  - Meningitis with cellular and proteinaceous debris
  - Carcinomatosis Meningitis
  - Pseudosubarachnoid Hemorrhage secondary to diffuse cerebral edema
  - Gadolinium Administration may cause FLAIR hyperintensity near pathology
  - High-Inspired Oxygen as in during general anesthesia, may present as hyperintensity on FLAIR

For more information, please see the corresponding chapter in [Radiopaedia](#).

Contributor: Priya Rajagopalan, MD