Pearls & pitfalls in emergency radiology
Brain- CT scan

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Missed intracranial hemorrhage

- Certain types of subtle hemorrhages may be overlooked, especially subdural and subarachnoid hemorrhages.

- A study of overnight preliminary head CT interpretation by strub WM found that the types of hemorrhages most often missed were subdural hemorrhages 39% (especially frontal & parafalcine).

- Subarachnoid hemorrhages 33% (interpeduncular cistern).

- Occipital horns of the lateral ventricles should also be specifically evaluated, as these are sites where a tiny amount of hemorrhage may be seen.
Images from head scan are routinely reviewed in axial plane, but hemorrhages oriented in a horizontal plane are prone to volume averaging effects (false negative results).

The additional of coronal and sagittal reformation scan lead to a more accurate diagnosis of intracranial hemorrhage.

A study by (S.C. Wei done at Massachusetts) of 109 patients with intracranial hemorrhage found that the addition of coronal reformations resulted in a change in interpretation in approximately 25% of cases, compared with axial images alone.
Axial non-enhanced CT image from a 9-year-old boy with head trauma from a motor vehicle accident
Axial non-enhanced CT image from a 43-year-old man
Axial non-enhanced CT image from a 67-year-old woman with head trauma
Another cause of missed hemorrhage involves the use of inappropriate window width values.

If the window is too narrow, a small subdural hemorrhage may be difficult to distinguish from the adjacent bone.

Optimal values vary among scanners but a window width of 200 and a level of 50 is a reasonable starting point.
Montage of three axial non-enhanced CT images from a 22-year-old man shows a small right frontal subdural hemorrhage (arrow).

The image on the left has a window of 80 and level of 40; the middle image has a window of 150 and level of 50; the right image has a window of 200 and level of 50.
Isodense subdural hemorrhage

- Subdural hematoma is the most common extra-axial collection and is present in up to 10-20% of head trauma patients.
- Typically appear as a crescent-shaped fluid collection.
- As a rule, subdural hemorrhages can cross sutures, but cannot breach the dural attachments.
- Subdural hemorrhage will displace the cortical vascular structures medially, compress and mildly displace the underlying brain.
- The typical attenuation of subdural hemorrhage can vary depending on acuity.
Subdural hemorrhage that is isodense to brain parenchyma is typically subacute.

But sometimes, isodense subdural hemorrhage can be **acute** in patients who are anemic (serum hemoglobin <8-10mg/dl)*

**Contrast-enhanced CT can detect isodense subdural hemorrhage.**

Enhancement of the dura, displacement of the cortical veins away from the skull, and cortical enhancement all help make the hemorrhage more conspicuous.
Importance

Isodense Subdural hemorrhage can be difficult to detect on a non-contrast CT, but can grow rapidly if undetected.

Consider *contrast enhanced CT* to detect subtle subdural hemorrhage or isodense hemorrhage in *anemic* patients.
Axial non-contrast head CT from a 69-year-old woman involved in a high-speed motor vehicle collision. The patient’s Hb at the time of the study was 8.4 g/dL.
Differential diagnosis

- **Subdural hygroma**: are isodense to (CSF) on non-contrast CT and follow CSF signal on all MR pulse sequences.

- **Dural thickening**: This can be patchy or diffuse.
  - CT is nonspecific.
  - MR demonstrates a *characteristic dural signal* that is
    - **Dark band on T2**-weighted images between the calvarium and subarachnoid CSF.
    - **bright on FLAIR**.
    - **Strongly enhances** on post-contrast images
Axial non-contrast head CT from an 80-year-old man with altered mental status
Axial NON contrasted CT image shows diffuse pachymeningeal thickening (man with tuberculous meningitis)
Pseudo-subarachnoid hemorrhage

- **Pseudo-SAH** refers to increased attenuation within the basal cisterns and subarachnoid spaces that mimics SAH
  - Diffuse cerebral edema is the most common cause of pseudo-SAH, which leads to
    - Decreased brain parenchyma attenuation
    - Compression of Dural venous sinuses, which may lead to venous congestion and engorgement of superficial veins
  - Other causes include meningitis, and intrathecal contrast
Typical clinical scenario

- The clinical scenario is helpful in arriving at the correct diagnosis. Patients with pseudo-SAH often have a history of an anoxic event, such as cardiac arrest.

- The rare cases of meningitis that may cause pseudo-SAH will usually have supporting clinical signs and symptoms.
Axial non-enhanced CT image from a 35-year-old man with cardiac arrest
Axial non-enhanced CT image from a 48-year-old man two days after an acute myocardial infarction.
Non-aneurysmal perimesencephalic subarachnoid hemorrhage

- Most common cause of non-traumatic subarachnoid hemorrhage (SAH) is aneurysm rupture (85%).

- Approximately 15% of patients will have no identifiable cause on CT angiography (CTA), SAH will have a pattern known as (NAPH).
Criteria have been established for NAPH, and include the following:

- Subarachnoid hemorrhage within the perimesencephalic cisterns, centered anterior to the midbrain.
- Possible extension into the posterior aspect of the anterior interhemispheric fissure, but not completely filling the anterior interhemispheric fissure.
- Possible extension into the medial aspects of the Sylvian fissures, but no extension laterally within the fissures.
- Possible small amounts of layering intraventricular hemorrhage sedimentation, but no frank intraventricular hemorrhage.
- No intraparenchymal hemorrhage.
Axial non-enhanced CT image from a 42-year-old man with an acute headache
Axial non-enhanced CT image from a 48-year-old woman with an acute headache
Patients with NAPH have a much more favorable outcome, complete recovery in 97% and can be managed less aggressively.

The patients are more likely to be younger and less likely to be hypertensive than those presenting with aneurysmal hemorrhage.

Cases which fulfill the criteria of NAPH and demonstrate no cause of hemorrhage on CTA do not require further investigation with DSA.
Teaching point

- Identification of NAPH is important in determining the prognosis and need for follow-up imaging.
- A confident diagnosis of NAPH may preclude the need for DSA.
Thank you