An Approach to Emergency Department Head CT Scan Interpretation

Five areas of evaluation:
When evaluating a head CT, systematically examine the following five areas for abnormality. This will assure that no acute lesions are missed. The five areas include:

1. Ensure adequate scan
2. Bone
3. Ventricles
4.Cistern
5. Parenchyma

Adequacy of the Scan:

Determination of the adequacy of the head CT scan helps the reader to assess if the patient is square in the scanner, weather contrast is used, correct slice thickness is used, the reader is viewing the appropriate scan, and if enough slices are seen. If the scan is inadequate or poorly performed, the information obtained will be misleading.

Examine the films to determine if the patient is square in the scanner. This will affect how you read the rest of the images. To determine this, compare the sphenoid ridges for symmetry, and be sure you can see both optic lenses in the same slice. If the patient s head is tilted, remember which side is slicing higher so that future apparent asymmetry of the ventricles or gray matter will not be mistaken for a bleed or mass effect. (i.e. the sphenoid ridge may remain in higher scans on one side due to the tilt and this asymmetry could be mistaken as a bleed.)

Establish that you have obtained an adequate number of slices. Slices should start at the foramen magnum and continue up to the top of cranium. The last slice should show only bone. If it does not, you could be missing a hematoma/hemorrhage at the apex of the skull. The slices through the posterior fossa are 5 mm thick and then 8-10 mm thick throughout the remaining brain. In children, slick thickness should be 5 mm for the entire brain.

Determine whether the study is enhanced or not, as unexpected contrast can be confused with blood. The scan will be marked if the radiology technician administered contrast. However, the patient may have received contrast for another reason such as an abdominal CT or IVP. If contrast is present, the falx cerebri will light up (i.e. be brighter). Also, with enhanced scans, you can sometimes see vasculature light up such as the Circle of Willis, and the sagittal sinus.

The setting used to view the brain are a level of 40 and a window of 80. To view the bone, use a level of 300 and a window of 1500.

Bone:

The bone windows should be examined for evidence of fracture as a clue to underlying intracranial pathology. Be sure to inspect the soft tissues for swelling and defects (i.e. lacerations). Determine if there are any depressed fractures, or pieces of bone missing (i.e. previous surgery). Look at the scout film, it is a free skull plain radiograph.

Ventricles:

Inspect the ventricles for size, shape, spatial relationship, and the presence of the blood. The two lateral ventricles have three horns each; the frontal, occipital, and temporal horns.
The frontal and occipital horns are easily identified, but the temporal horns can be a little bit more difficult. They will not always be seen. However, symmetry is the key. If you see one, you should the other. They will be located slightly anterior to petrous ridge on approximately the same slice or one above the petrous ridge, and are shaped like an L . Obliteration of these is caused by medial movement of the temporal lobes (secondary to mass effect or hematoma), tumor, or prior

surgery. Increase in the size of the temporal horns is due to atrophy or increased CSF (i.e. hydrocephalus).

The frontal horns may be compressed secondary to mass effect and subsequently resemble a pair of parentheses back to back)(. They can also be enlarged due to hydrocephalus or atrophy (see a recurring theme here?).

The occipital horns contain the choroid plexus which produces CSF. Do not mistake the choroid plexus for blood in the ventricle. Blood in the ventricle will tend to settle to the posterior aspect of the occipital horns because the patient is lying down in the scanner. This is not always true as the blood may have clotted while patient was in another position. Blood will be hyperdense (white) if it is acute. Again, dilated horns are caused by atrophy or increased CSF volume.

The third ventricle is midline, slit-like structure that lies between the thalamus. It forms an exclamation point with the pineal gland as the point **!** . Loss of this structure may be the cause of dilated lateral ventricles and is itself a result of mass effect. Remember, if it is white, it contains blood.

The fourth ventricle is located below the petrous bones in the posterior fossa. Look for an oval shaped area just posterior to cerebellar vermis. If you look in slices above the petrous bones, you are looking too high. Once again, dilation means atrophy or hydrocephalus.

If significant blood is noticed in the ventricles or significant mass effect, re-examine the fourth ventricles again. This is the ideal situation when a second look could show them to be larger than normal demonstrating acute hydrocephalus.

Cistern:

______The quadrigeminal cistern is often difficult to locate, shaped like a smiley face or a baby s bottom depending on how you look at it. (I know there is a joke in there somewhere). To find it, first locate the scan with the dorsum sella in it and number that scan 0. The quadrigeminal cistern should be located in the first or second scan above scan 0. If you find the pineal gland, you have gone too far, because the cistern is located below the pineal gland. Loss of this structure again should raise suspicion of mass effect due to tumor, edema, or bleed.

Parenchyma:

______The parenchyma should be viewed by comparing one side to the other. This is where knowing how your scan is tilted will save you from making false calls. Ischemic areas will appear hypodense (black) whereas blood will appear hyperdense if it acute. A tumor may be very difficult to detect on a non-contrast CT as it may isodense to the surrounding brain tissue. When evaluating masses in the brain tissue, remember there tends to be more edema surrounding a metastatic lesion than a primary tumor of the brain. One must look for associated bleedings, mass effect, or asymmetry as compared to the other side.

Subdural hematomas appear as crescent-shaped lesions that follow the contour of the skull. They will cross suture lines but will not cross the falx or the tentorium. Epidural hematomas, on the other hand, will be lenticular-shaped (biconvex) and have a sharply defined edge because it lies between the dura and the skull. Epidurals will not cross suture lines, but cancross midline. If the hematoma is acute, it will be hyperdense (whiter) in comparison to the brain. A hematoma that is subacute (1-2 weeks old) will appear isodense with the surrounding brain, unless it is accompanied by a superimposed acute bleed. If the lesion appears hypodense (darker or blacker), it is either a chronic hematoma or due to a hygroma (CSF leak).