Stroke Imaging

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STMH

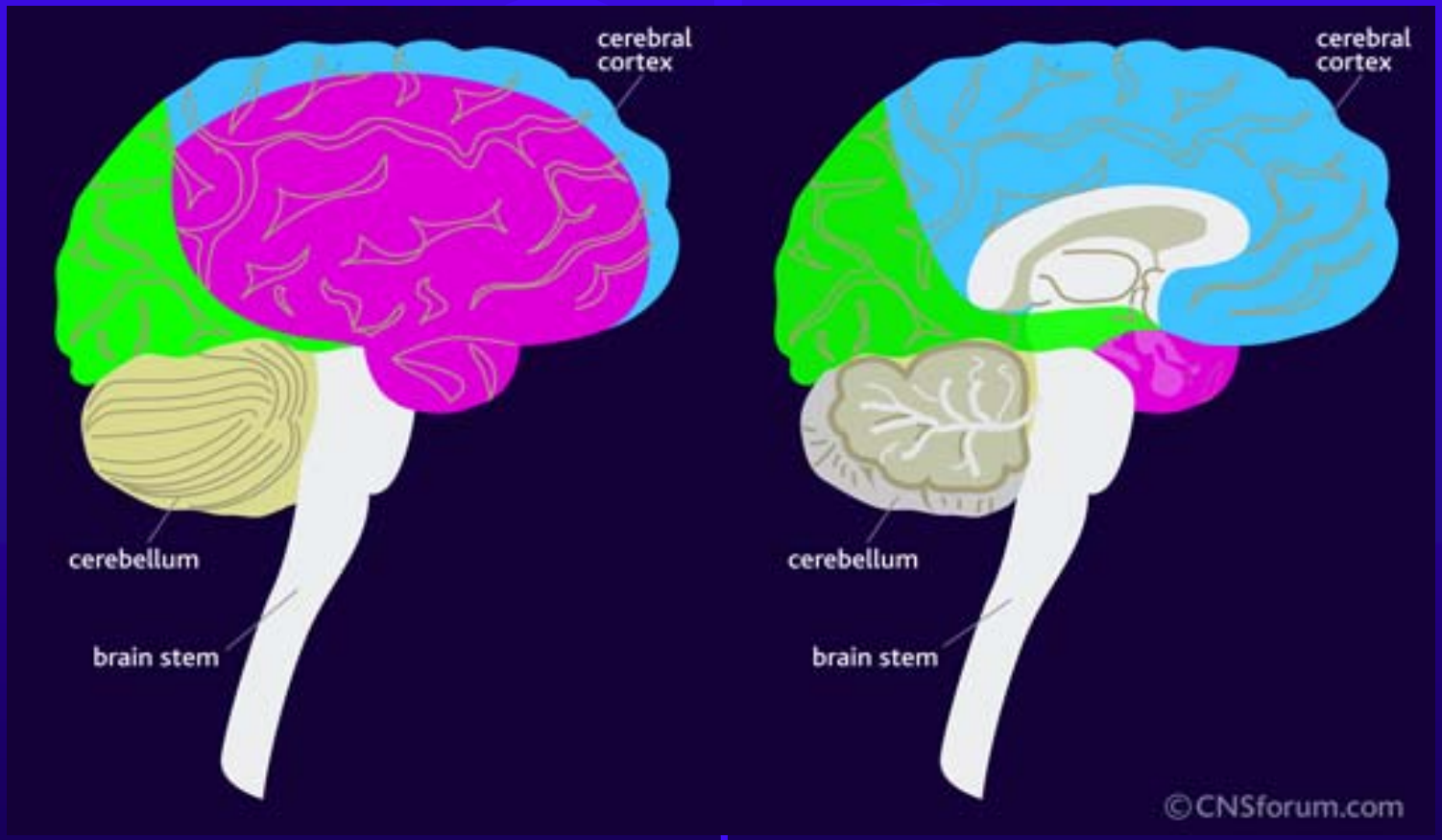
Vascular Distributions

- Blood supply to the brain:
  - Anterior Circulation:

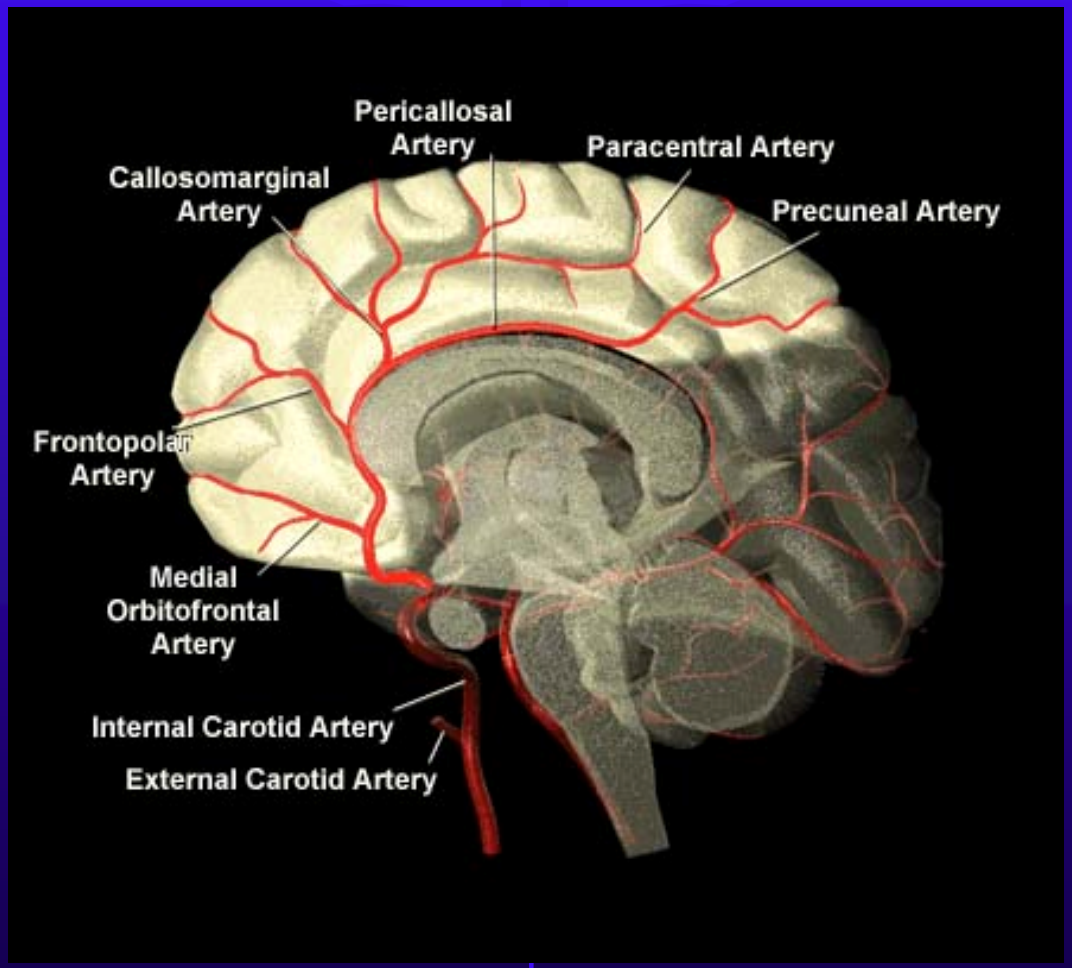
    Internal Carotid Arteries (supply anterior 2/3 of cerebral hemispheres
  - Posterior Circulation:

    Vertebral Arteries → Basilar Artery

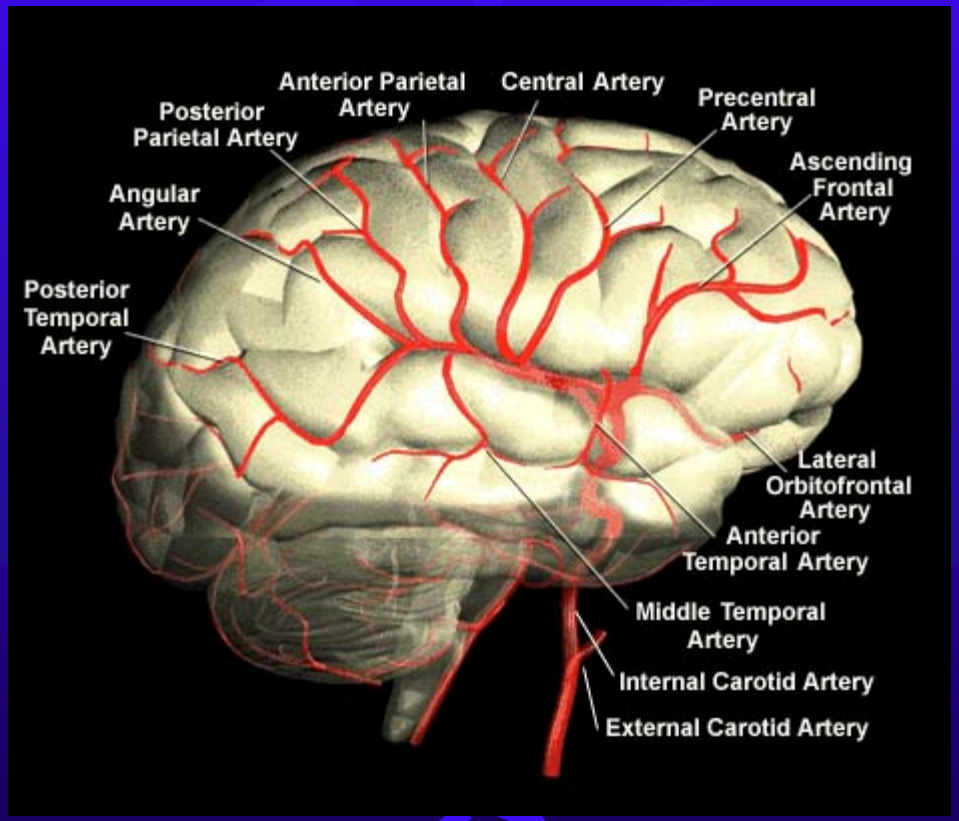
Vascular Distribution



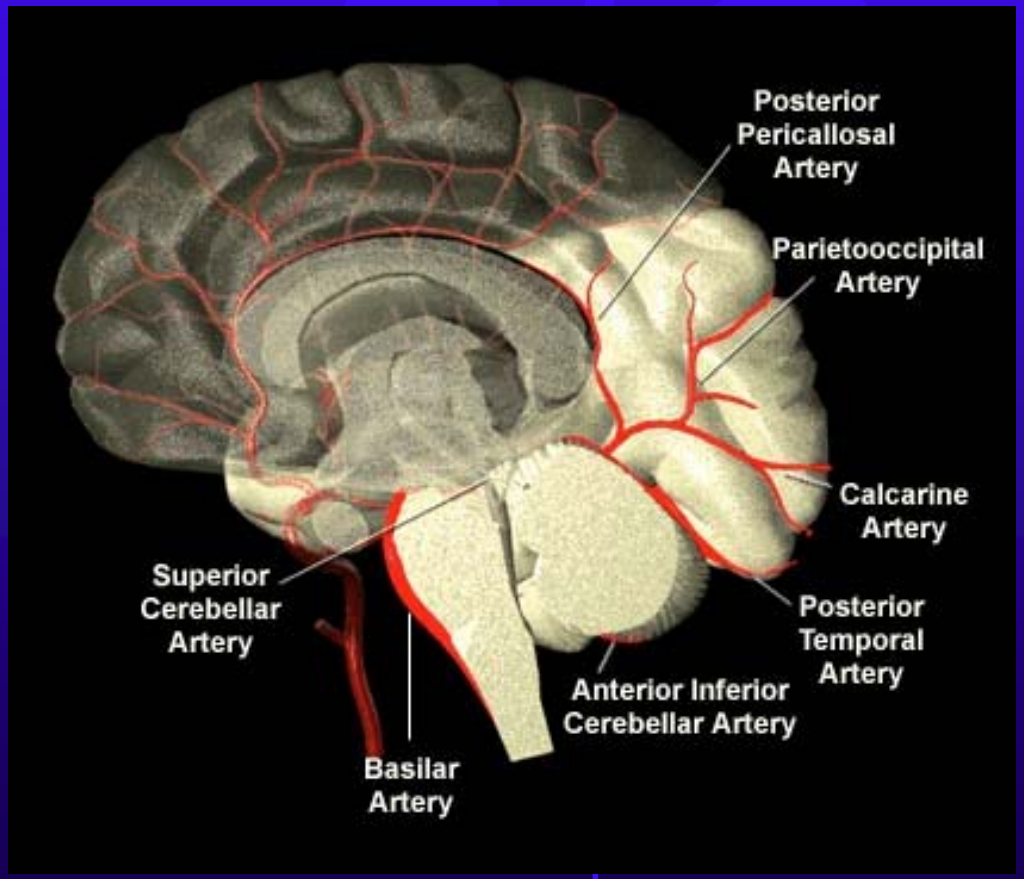
Anterior Cerebral Artery



Middle Cerebral Artery



Posterior Cerebral Artery



Presentations

- TIA
- Ischemic Stroke
- Intraparenchymal Hemorrhage
- Hemorrhagic Infarction

Why do we need to recognize these conditions?

- Each of these conditions presents with different imaging characteristics on both CT and MRI.
- The clinical history along with the imaging presentation help define and guide treatment

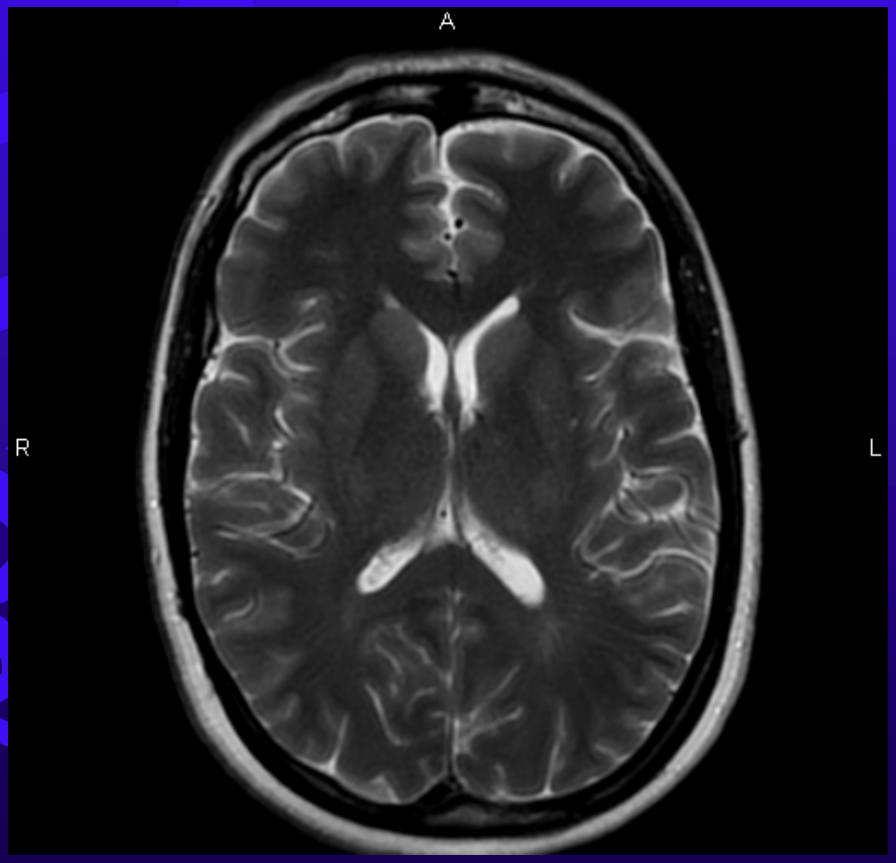
Imaging of Stroke

- CT
- MRI/MRA
- Ultrasound
- Conventional Angiography

Transient Ischemic Attack

- Neurological deficit of presumed vascular origin lasting less than 24 hours (and usually lasting only minutes)
- CT and MRI imaging show no findings related to this event

Normal Brain



Ischemic Stroke

- Term used to describe neurological changes lasting more than 24 hours and resulting from inadequate supply of blood and oxygen (blockage of oxygen-rich blood supply)
- There are many causes of stroke but the major cause is thromboembolic disease (atherosclerosis, cardiac and pulmonary sources, dissection)

Imaging Findings in Acute Ischemic Stroke

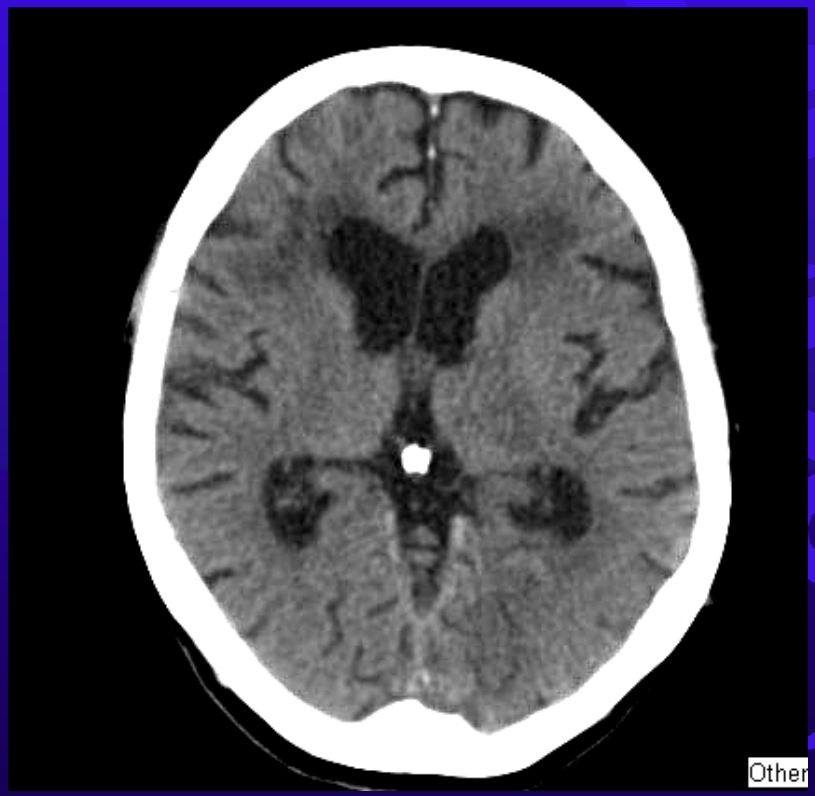
- CT
  - Hyperdense artery
  - Within 6 hrs there is loss of gray-white matter differentiation
  - Within 12-24 hours an indistinct area of low density is seen
  - Mass effect becomes more apparent at 24 hours (peaking at 3-5 days)
  - Increased circulation (luxury perfusion) thru the infarct may be seen between the 1st and 3rd week following the infarct
  - Well circumscribed low density region is noted at 4 weeks (with no mass effect)

Imaging Findings in Acute Ischemic Stroke

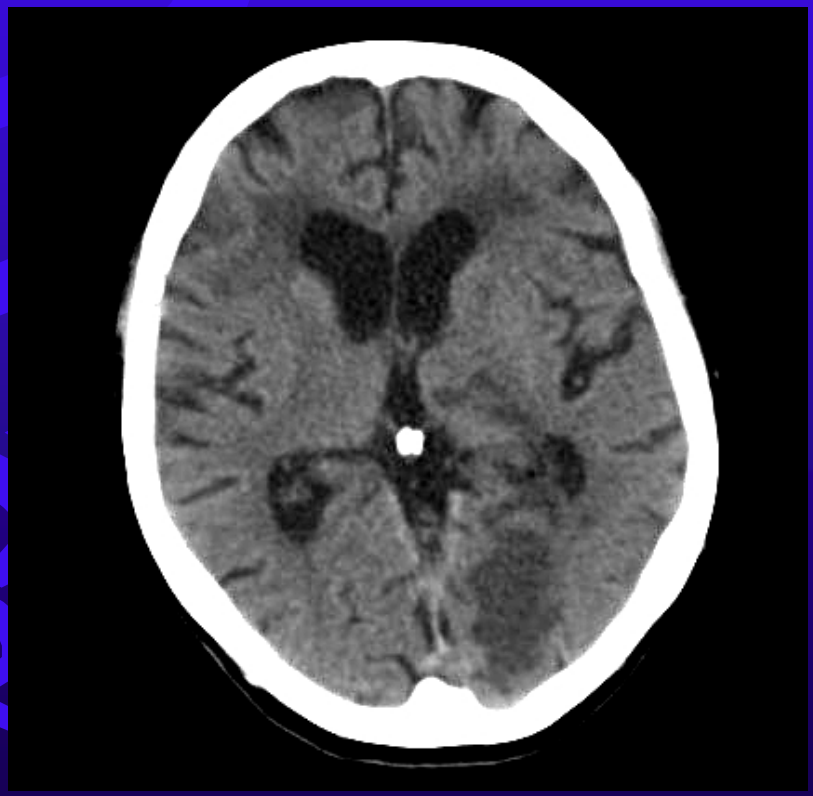
- MRI
  - Swelling of cortex within first few hours w/o changes in signal intensity
  - Signal changes (hyperintense on T2WI and FLAIR) by 8 hours
  - Diffusion weighted images can detect acute stroke within 1 hour of onset
  - Lack of flow void may be seen in up to 50% of ischemic lesions

Acute Infarct - CT

Presentation



2 Days Later



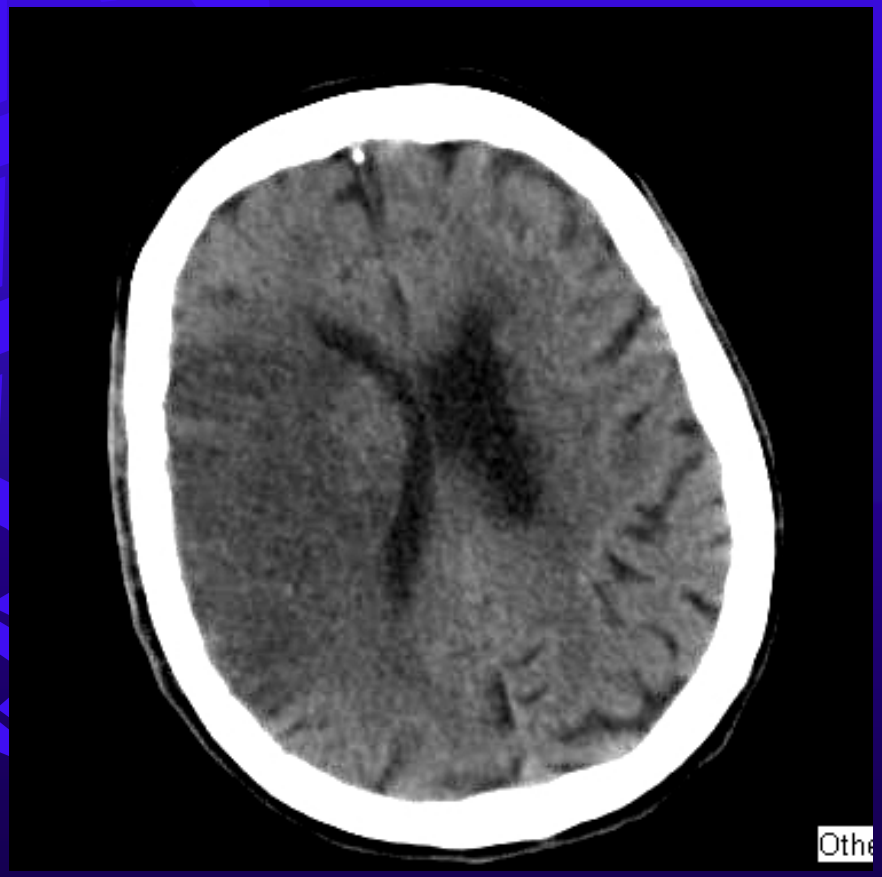
Acute Stroke - CT

Presentation

Acute Stroke - CT

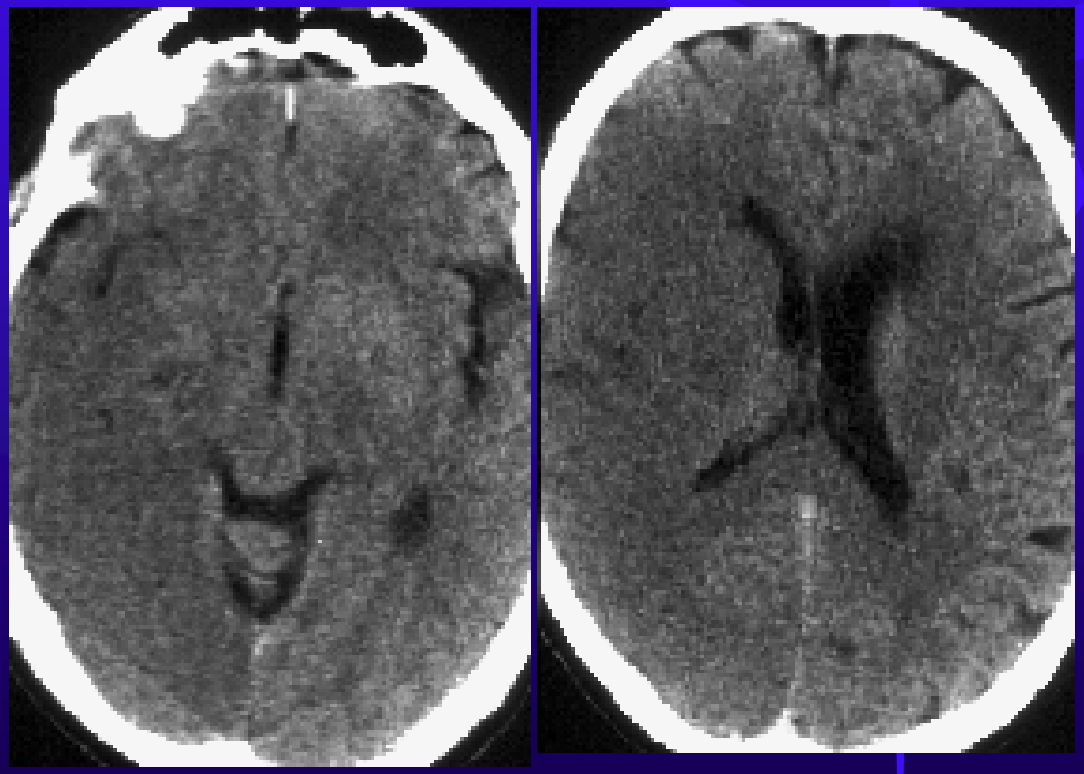
Presentation

2 Days Later

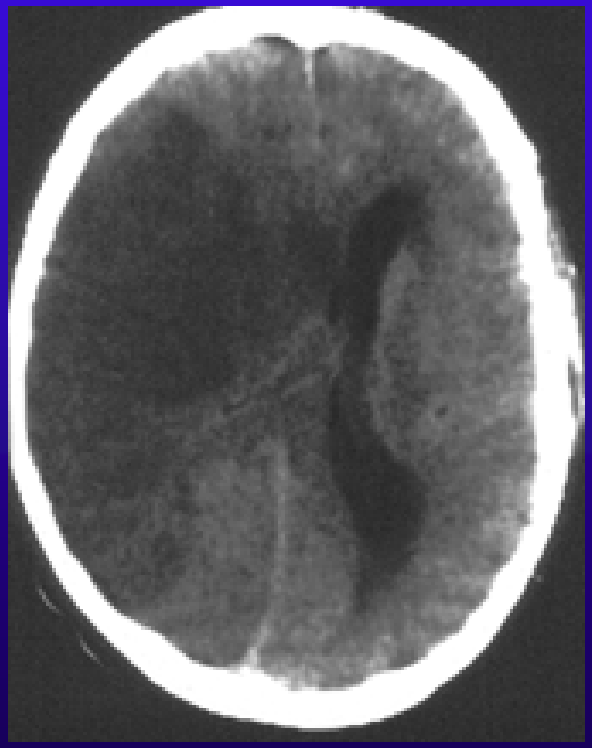


Acute Stroke - CT

Presentation

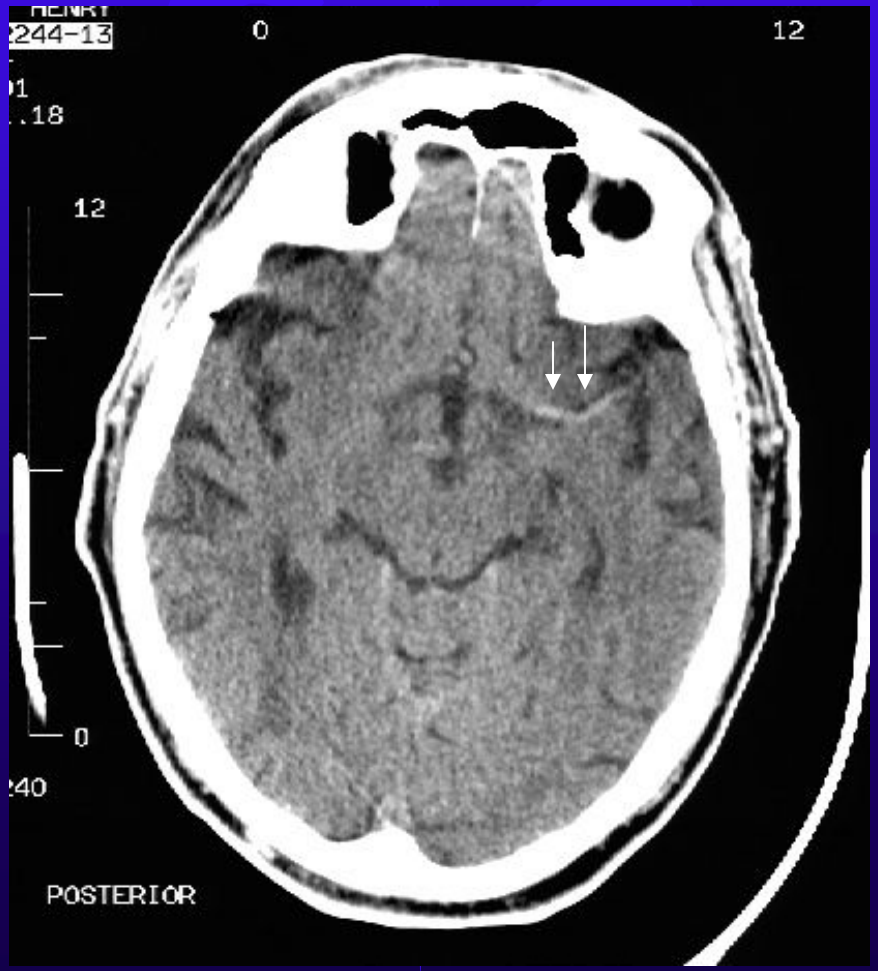


24 Hours



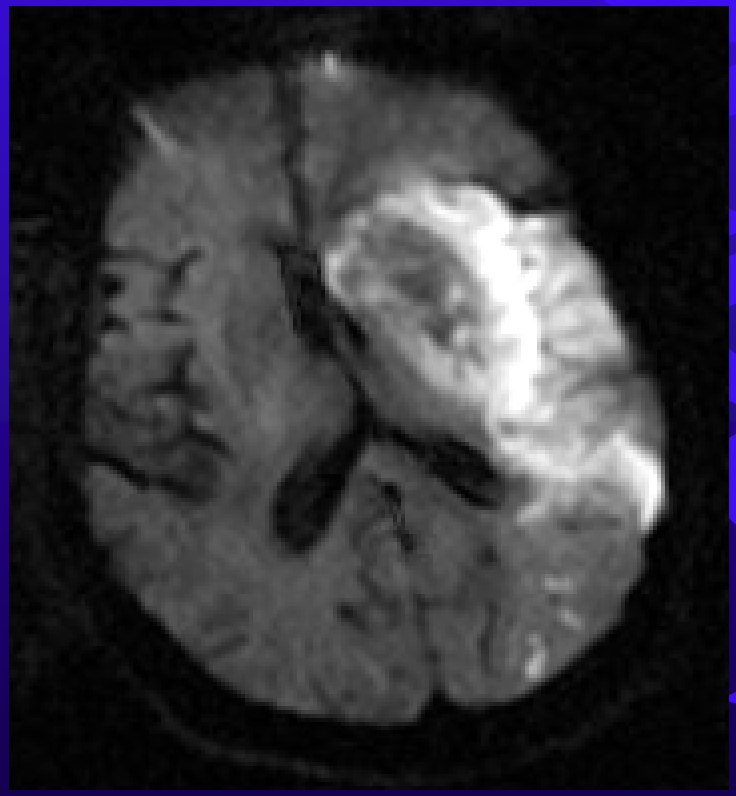
Acute Stroke - CT

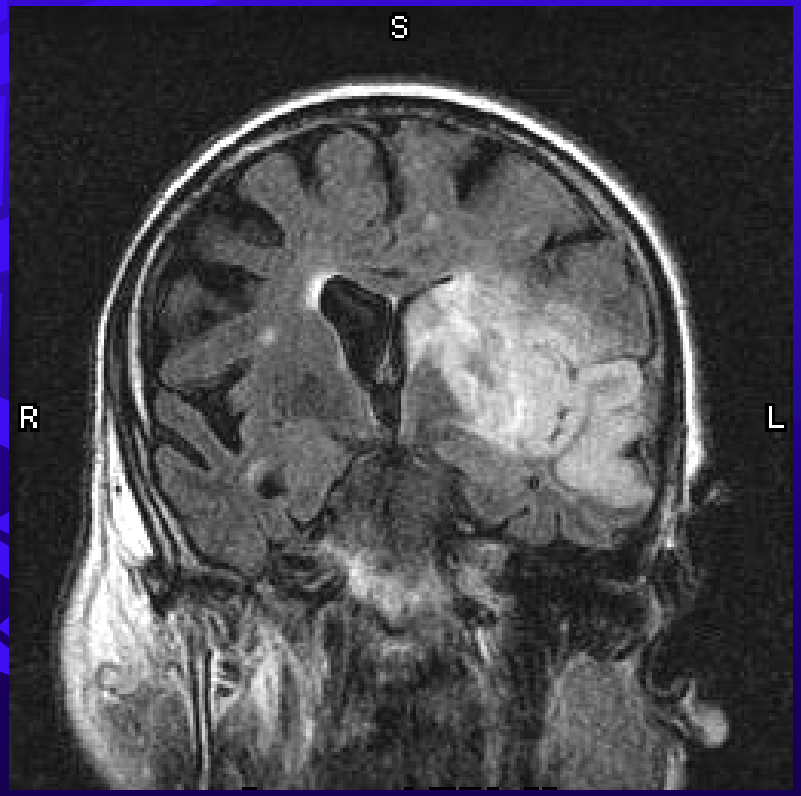
Presentation



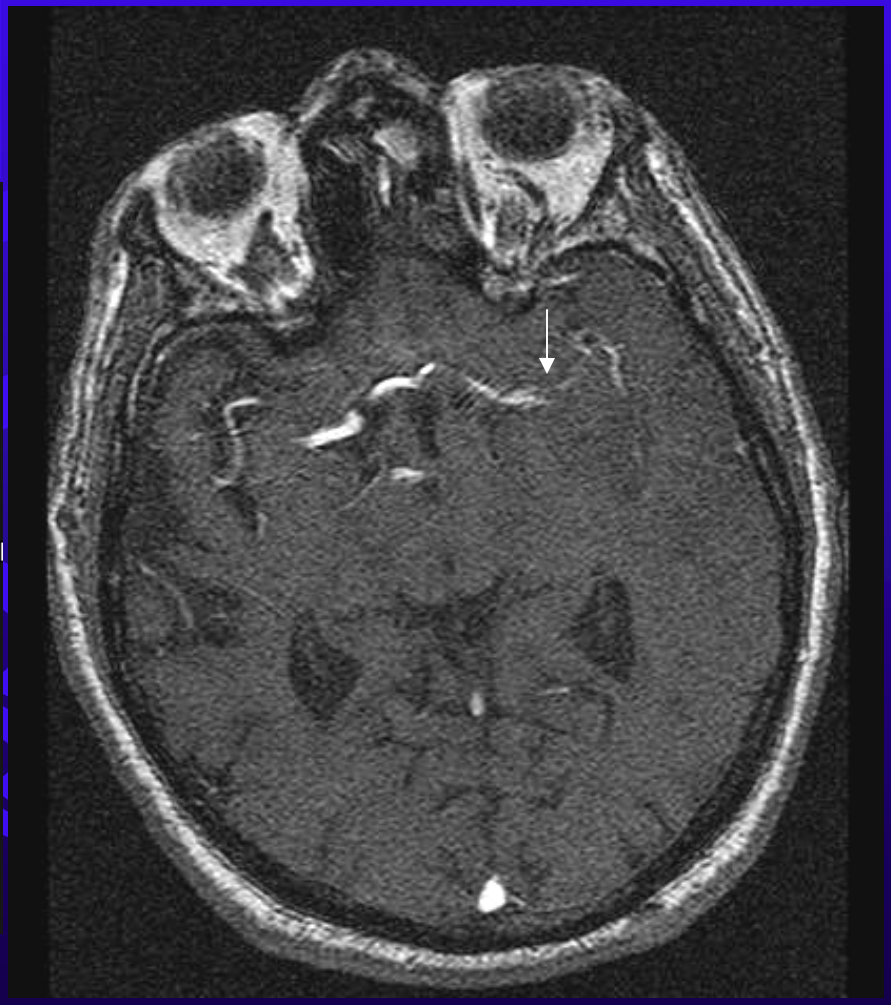
Acute Stroke - MRI

24 Hours





Acute Stroke - MRA



Intraparenchymal Hemorrhage

- Primary event in approximately 10-15% of strokes
- Hypertension is the presumed cause in nontraumatic intraparenchymal hemorrhage in approximately 70-90% of cases
- Other etiologies: Aneurysms, neoplasm, amyloid angiopathy, vasculitis, drugs
- Approximately two thirds occur in the basal ganglia/thalamic region

Imaging Findings of Intraparenchymal Hemorrhage

- CT

  -CT density of blood is directly related to protein content (Hemoglobin)

  -After extravasation of blood , a clot forms with progressive increase in density for 72 hours

  -After 72 hours, RBC's containing desaturated Hg undergo lysis and digestion by peripheral macrophages with the hemorrhage eventually fading to isodensity

Imaging Findings of Intraparenchymal Hemorrhage

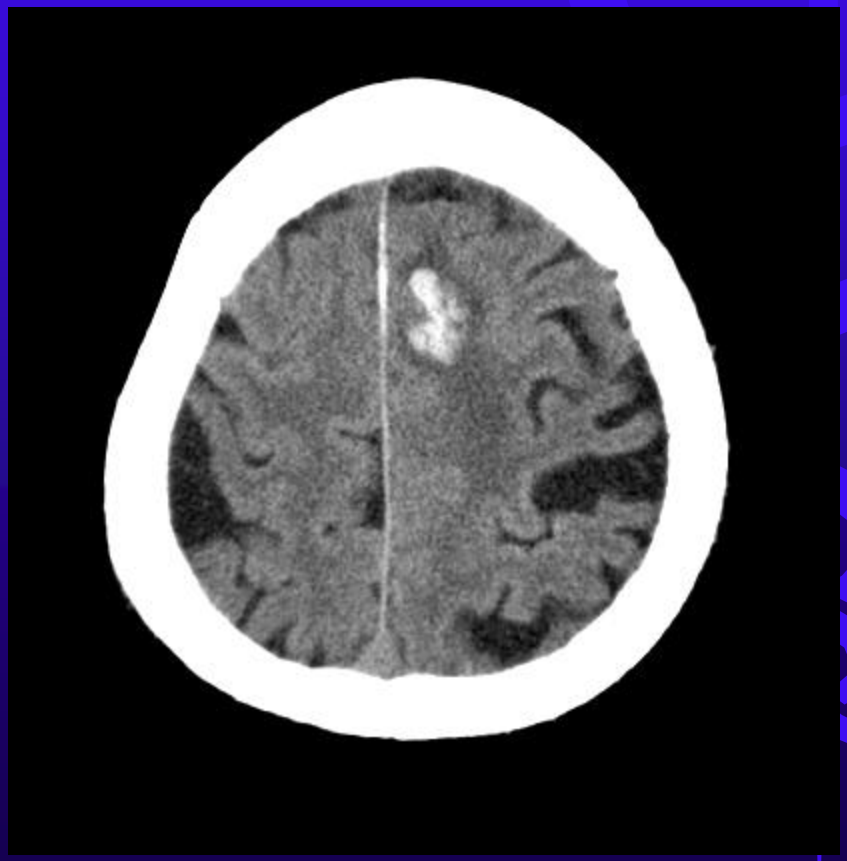
- MRI

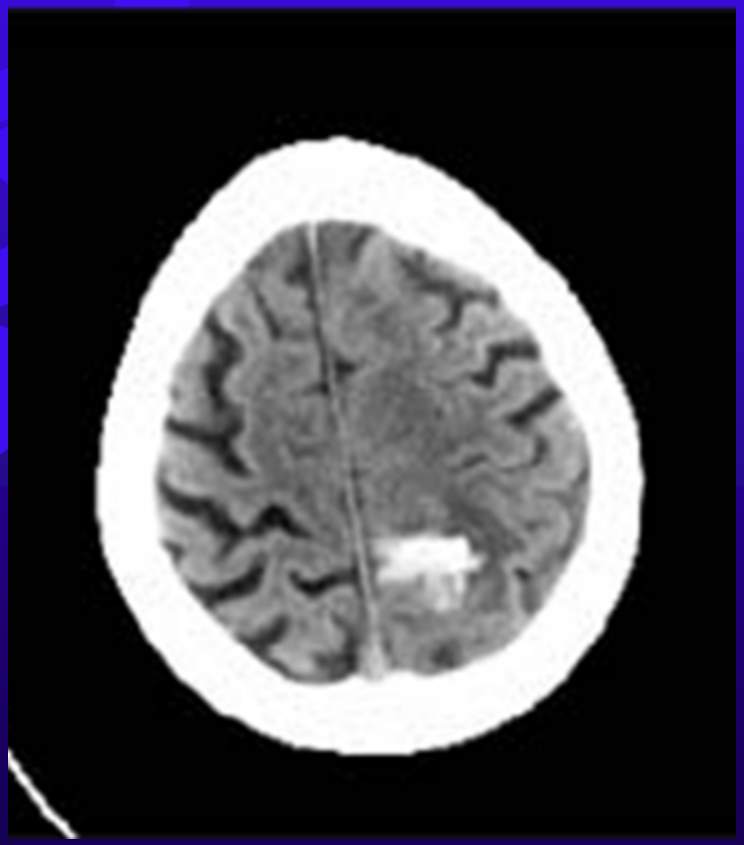
  - Different stages of hemorrhage have different intensities on T1 and T2 images (intracellular vs extracellular, oxyHG vs deoxyHG vs metHG vs hemosiderin)

  - Understanding MRI imaging characteristics of these different stages can delineate the time course of hemorrhage

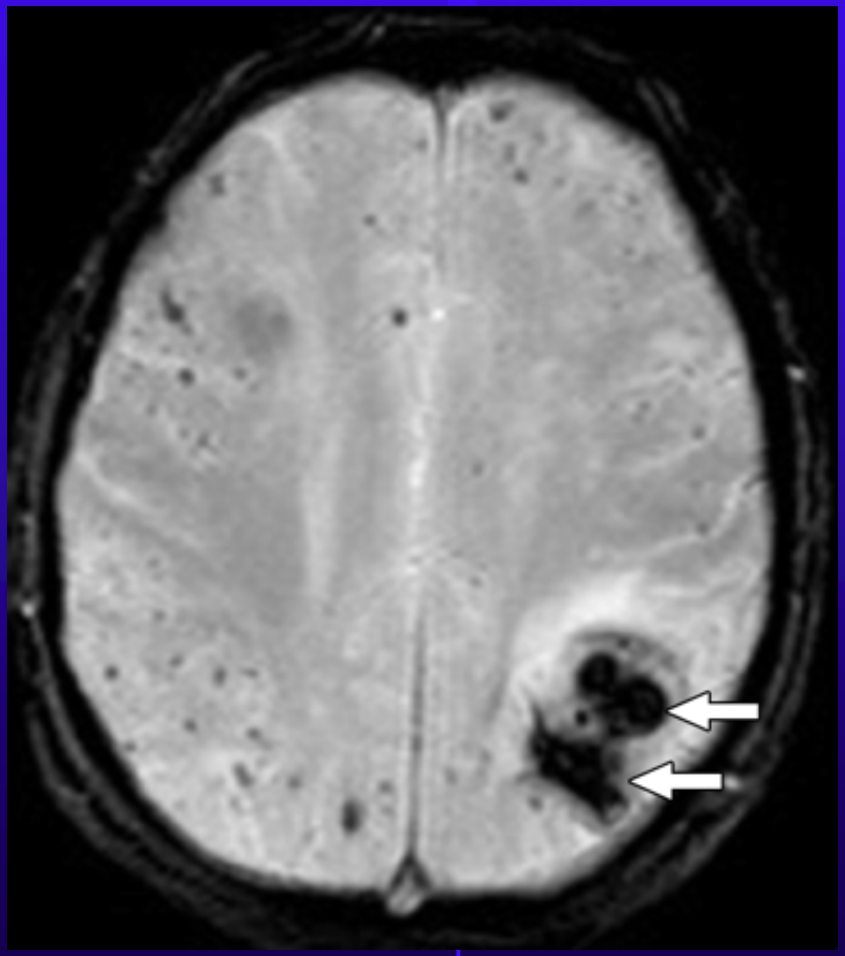
Hypertensive Hemorrhage

Amyloid Angiopathy



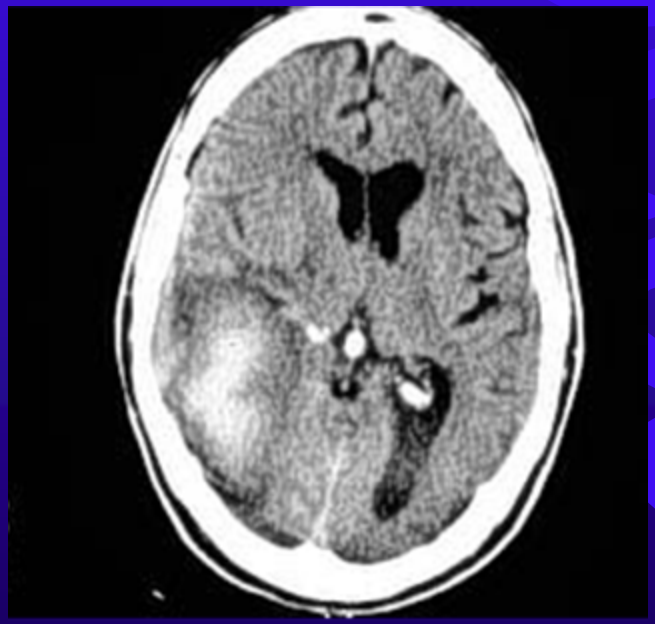


Amyloid Angiopathy



CT Appearance of Clot Retraction

Subacute (weeks)



Chronic (months)

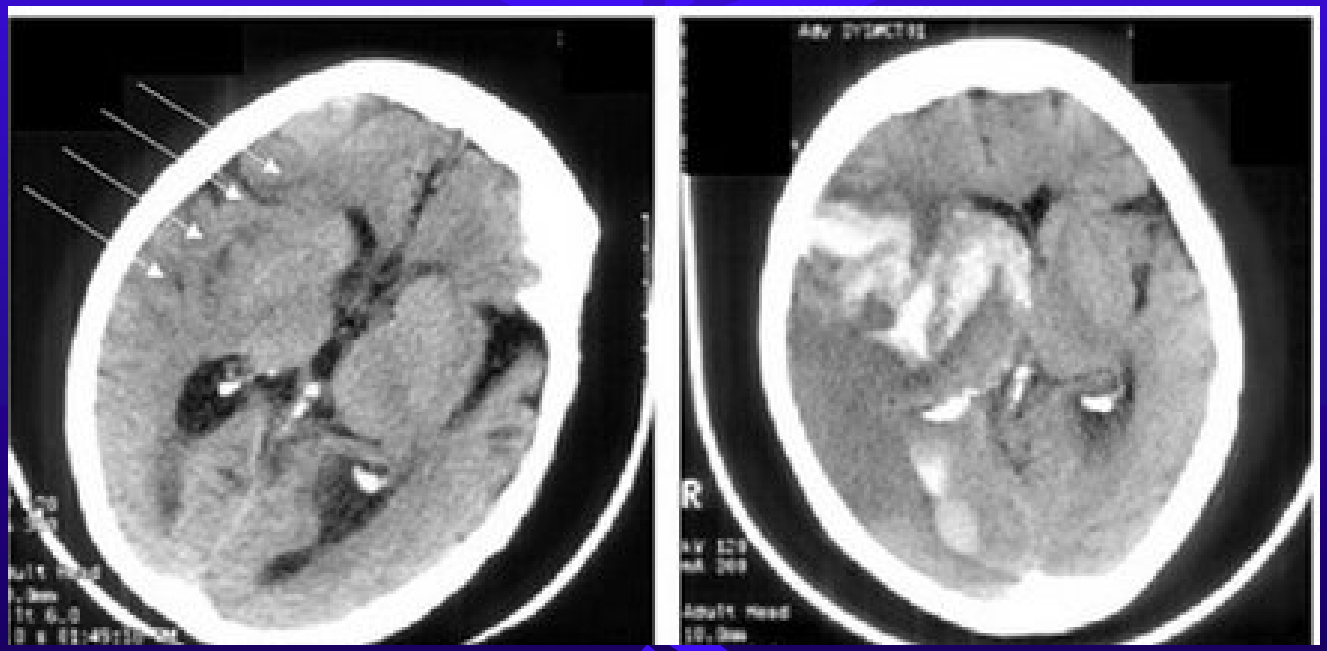
Hemorrhagic Infarction

- A secondary event related to blood extravasating into infarcted tissue.
- Hemorrhagic transformation typically is delayed for 6-12 hrs and is usually present by 48 hrs (although it can be seen after 1 week)
- Two things need to happen for this to occur: change in vascular permeability and blood needs to reach the damaged vessel (collateral circulation or partial lysis of proximal embolus/thrombus)

Hemorrhagic Transformation

6 Hours

24 Hours Post Thrombolysis



Other Imaging Modalities

- Ultrasound
- CTA
- Conventional Angiography
  - Limitations: Invasive, Expense, Availability in the Acute Setting
- Perfusion Imaging

Role of Radiologist in Acute Stroke

- Recognize subtle signs as acute infarcts
- Differentiate ischemic versus hemorrhagic stroke
- Recognize vascular distribution of acute event
- Recognize cause of stroke (thromboembolic, aneurysm, neoplastic, etc). May be difficult to differentiate in the acute setting w/o benefit of contrast, MRI/MRA imaging, etc.