Neuroradiology of Hemorrhagic Stroke

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Goals

1. Mechanisms of stroke

2. What neuroimaging modalities are available

3. Uses for neuroimaging modalities

4. Patient presentation to illustrate the decision algorithm for workup of one type of stroke
Stroke pathogenesis

Ischemic stroke (80%)  The deficits adhere to vessel territories.
Embolic: usually cardiogenic in origin, less commonly artery-to-artery.

Thrombotic: caused by HTN, arteritides.

Hemorrhagic stroke (20%)
Intraparenchymal hemorrhage: causes include HTN, trauma, cocaine.
  Gradual onset, with neurologic findings that may cross vessel territories.

Subarachnoid hemorrhage: causes include arterial aneurysm and AVM.
  Sudden onset, excruciating headache and changes in mental status.

Rapid diagnosis and intervention is critical for preservation of brain function.
Menu of tests

Head CT
- quick
- sensitive for hemorrhage
- I+ contrast to visualize vascular anatomy
- but cannot detect acute infarction < about 8 hrs old
  first sign is loss of gray-white differentiation, sulcal effacement
  then decreased attenuation

Brain MR
- excellent visualization of anatomy
- sensitive to acute infarct (T2, FLAIR and DWI/ADC sequences)
- can see vessel flow with MRA (better with gadolinium contrast)
- but very slow to acquire images
- does not provide vessel anatomy (will overcall tight stenoses)

Cerebral Angiogram
- excellent vascular anatomy
- permits interventions (clot retrieval, targeted t-PA administration, coil embolization)
Stroke imaging algorithm

Rule out stroke

Head CT without contrast

Hemorrhage

HTN, aneurysm, AVM?

Interventional neurorads

Angiogram to study anatomy

Intervene, if possible

Coil embolization

No hemorrhage, infarct or masses

CTA

occluded vessel

Hyperacute ischemic stroke

If < 3 hrs, peripheral t-PA

clot retrieval, directed t-PA administration

MRI/MRA

T1, T2, > 6 hrs
FLAIR, > 2 hrs
DWI/ADC, > 30 min

TIME IS EVERYTHING!
Patient Presentation

J. B. is a 63 year old right-handed female who presents with:
- sudden onset of headache
- left sided weakness
- rapidly diminishing mental status

What imaging test would you perform first?
Normal neuroanatomy

- frontal lobe
- temporal lobe
- pons
- cerebellum
- lateral ventricles
- internal capsule
- thalamus
- superior colliculi
- corpus callosum
- septum pellucidum
- Sylvian fissure
- basal ganglia
- caudate nucleus
- lentiform nucleus
- falx cerebri
- gray matter
- white matter
- occipital lobe

Images from BIDMC
Initial Head CT

Images from BIDMC

temporal lobe
uncal herniation
midbrain
cerebellum
frontal lobe
falx cerebri
occipital lobe
calcified artery
hemorrhage
Sylvian fissure
pineal gland
lateral ventricles
Initial Head CT

- intraparenchymal hemorrhage
- Sulci (with subarachnoid hemorrhage)
- corpus callosum
- midline shift
- septum pellucidum
- calcified choroid plexus
- caudate nucleus
- internal capsule
- lentiform nucleus
- thalamus
- frontal lobe
- parietal lobe
- occipital lobe

Images from BIDMC
L ICA, AP projection

Arterial Phase
- ACommA
- L ACA (A2)
- L MCA (M1)
- L ICA

Capillary Phase
- L ACA (A1)
- L MCA (M2)

Venous Phase
- Sagittal sinuses
- Transverse sinus
- Sigmoid sinus

Images from BIDMC
L ICA, LAT projection

**Arterial Phase**
- L ACA (A2)
- L MCA (M2)
- L ICA

**Capillary Phase**

**Venous Phase**
- Superior sagittal sinus
- Bridging vein
- Transverse sinus
- Sigmoid sinus

Images from BIDMC
R ICA, AP projection

Arterial Phase
- R MCA (M1)
- R ACA (A1)
- ACommA
- L ACA (A2)

Capillary Phase
- Sagittal sinuses

Venous Phase
- Sigmoid sinus
- Transverse sinus

Images from BIDMC
R ICA, LAT projection

Arterial Phase

Capillary Phase

Venous Phase

L ACA (A2)

Superior sagittal sinus

Bridging vein

R MCA (M2)

R ICA

Transverse sinus

Sigmoid sinus

Images from BIDMC
Post-intervention Head CT

craniotomy

drain

hemorrhage

edema/infarct

new ischemic stroke

coils

herniation

ventriculostomy tube

Images from BIDMC
Post-intervention Head CT

- **craniotomy**
- **new infarction**
- **ventriculostomy tube**
- **drain**
- **staples**
- **herniation**
Summary

Rapid diagnosis and intervention is critical in stroke patients.

Head CT is the first line imaging in all suspected stroke patients.

Hemorrhage appears as high attenuation regions on CT.

Head CT can also detect masses and infarcts > 8-12 hrs old.

Interventional neuroradiology can offer interventions that minimize bleeding or rebleeding.
References

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