Approach to Acute Stroke in the Emergency Department

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Objectives

- Types of stroke
- Differentiating hemorrhagic and ischemic strokes:
  - Clinically and radiologically
- Stroke syndromes
  - Anterior circulation:
    - Middle cerebral artery
    - Anterior cerebral artery
  - Posterior circulation:
    - Posterior cerebral artery
    - Basilar artery
- Case examples
Types of Stroke

Ischemic 85%

- Large vessel 35%
- Cardioembolic 25%
- Lacunar 20%
- Other 5%

Hemorrhagic 15%

- ICH 10%
- SAH 5%
Differentiation Between Ischemic versus Hemorrhagic Strokes

- Hemorrhagic Stroke: Hemorrhage/blood leaks into brain tissue.
- Ischemic Stroke: Clot stops blood supply to an area of the brain.
Clinical Clues for Detecting Hemorrhagic Stroke

<table>
<thead>
<tr>
<th>Historical</th>
<th>Examination Findings</th>
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<tbody>
<tr>
<td>● Headache</td>
<td>● Decreased level of consciousness</td>
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<td>● Sudden onset but gradually worsening</td>
<td>● Hypertension</td>
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<td>● Nausea and vomiting</td>
<td>● Bradycardia</td>
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<td>● Seizures</td>
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<td>● Meningism</td>
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<td>● Fever</td>
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Patients with hemorrhagic stroke present with similar focal neurologic deficits but tend to be more ill than patients with ischemic stroke.
Other Clinical Clues

Causes:
- Uncontrolled hypertension
- Anticoagulants
- Coagulopathies
  - Known bleeding diathesis
  - Advanced liver disease
- Elderly with poor cognition (cerebral amyloid angiopathy)
- Known vascular malformations or aneurysms
- Brain tumours
Radiological Hallmarks

Urgent Non-contrast CT scan of the Brain

- Blood looks bright white
  - Don’t confuse this with cerebral calcification
- Parenchymal versus subarachnoid
- Location
  - Deep versus lobar
- Volume
- Ventricular extension
- Hydrocephalus
Location of Bleeds

- Deep 50%
- Lobar 35%
- Cerebellum 10%
- Brainstem 5%
66yo M with uncontrolled HT

Large deep ICH affecting left basal ganglia

Blood in the left lateral ventricle
87 yo F with dementia

Lobar L occipital ICH
Prognostic Factors in ICH

- Up to 50% mortality rates at 1 year
- Volume of hemorrhage predicts 30 day mortality
  - Poor functional outcomes >30ml ICH
  - >70ml ICH is usually fatal
  - Pontine hemorrhage, >5ml is usually fatal
  - Cerebellar hemorrhage, >30ml is usually fatal
Prognostic Factors in ICH

Hematoma Expansion

- 40% of hematomas expand by >1/3\textsuperscript{rd} of their volume
- More than 2/3\textsuperscript{rd} of hematomas grow in the first hour
- Hematoma expansion correlates with poor functional outcome
CT Angiography

- Vascular anomalies
- “Spot sign”
Ischemic Stroke

- Common
  - Every 45 secs, someone has a stroke

- Devastating
  - For every 10 stroke patients:
    - 2 will die
    - 2 will recover
    - 6 will be left with disability

- Potentially treatable (thrombolysis)
The Ischemic Penumbra
The Ischemic Penumbra: A Dynamic [time + space] concept
Clinical Clues of Ischemic Stroke

**Historical Clues**
- Cardiovascular risk factors:
  - Smoker
  - HT
  - Hypercholesterolemia
  - Diabetes
  - Family history
- Prothrombotic disorder
- AF
- Cardiomyopathy
- Valvular heart disease

**Physical Examination**
- Stroke syndrome pertaining to one vascular territory

**Bottom line:**
- You can’t differentiate between ischemic and hemorrhagic stroke purely on history and physical examination
- Imaging is required!
Radiological Features of Ischemic Stroke

- Infarcts look hypodense (dark) on CT
Radiological Features of Ischemic Stroke

- Hemorrhagic transformation
Hyperdense Vessel Sign
Ischemic Stroke Syndromes:
Middle Cerebral Artery Occlusion

Figure 3A. Schematic diagram of the arteries to the brain, and the circle of Willis.
MCA

Frontal and parietal and temporal lobes (spares paramedian area)

Basal ganglia and internal capsule

Frontal and parietal and temporal lobes (spares paramedian area)
Homunculus
Middle Cerebral Artery

- Contralateral hemiparesis (face, arm>leg)
- Contralateral hemisensory impairment
- Contralateral homonymous hemianopia

Specific hemispheric signs:
- Left (dominant hemisphere)
  - Aphasia (expressive, receptive, global)
- Right
  - Dysarthria
  - Neglect
MCA Infarct on Non-Contrast CT Brain

The MCA supplies the frontal, temporal and parietal lobes

Large MCA territory infarct with hemorrhagic transformation
Figure 3A. Schematic diagram of the arteries to the brain, and the circle of Willis.

- Anterior communicating artery
- Anterior cerebral artery
- Middle cerebral artery
- Posterior communicating artery
- Posterior cerebral artery
- Basilar artery
- Optic chiasma
- Vertebral artery
ACA

Corpus callosum

Caudate and anterior limb of internal capsule

Paramedian frontal and parietal lobes
Anterior Cerebral Artery

- Contralateral weakness of leg >> arm
- Contralateral hemisensory impairment in the same distribution
- Mood and cognition disturbance:
  - Depression
  - Agitated confusion
  - Emotional lability
CT showing ACA Territory Infarct

Hypodense area L paramedian frontal lobe
Ischemic Stroke Syndromes
Basilar Artery Occlusion
Basilar artery supplies the cerebellum, brainstem, the occipital lobes, medial temporal lobes, and thalami.
Symptoms associated with Posterior Circulation Strokes

- Slurred speech
- Trouble swallowing
- Double vision
- Vertigo
- Contralateral weakness
- Crossed sensory signs
- Cranial nerve palsies
- Ipsilateral incoordination
- Unsteady gait
- Fluctuating level of consciousness
- Hearing loss
Initial Non-contrast CT Brain often looks Normal

Right pontine stroke on MRI
Ischemic Stroke Syndromes
Posterior Cerebral Artery
PCA

- Occipital lobe
- Medial temporal lobe
- Thalamus

- Occipital lobe
- Medial temporal lobe
- Thalamus
Ischemic Stroke Syndromes
Posterior Cerebral Artery

- Contralateral hemianopia
- Confusion and memory disturbance
Case Example 1

- 76 yo R handed M
- Sudden onset of
  - Difficulty speaking (non-fluent, unable to read or name)
  - Right weakness (arm>leg)
  - Right sensory impairment
- 90 mins duration
- No headache
- History of CAD / HT / chol
- On aspirin

- Does this presentation conform to a particular stroke syndrome?
- Which hemisphere is affected?
Diagnosis?
Follow-up CT’s
Case Example 2

- 79 yo R handed F
- Background: Uncontrolled HT (non-compliant)
- Sudden onset of headache, nausea and vomiting
- Now drowsy with right hemiplegia
- BP 230/105mmHg

What do you think the CT will show?
Where will the lesion be based on clues from the history?
Case Example 3

- 80 year old woman
- 1 hour history
  - Acute hemiplegia
  - Gaze deviation
  - Hemispatial neglect
- A fib
Mean transit time prolonged (red)

Cerebral blood flow reduced (blue)

Mismatched defect in the right MCA territory

Cerebral blood volume normal
Case Example 4

- 67 yo R handed female
- Sudden onset 3 hours ago
  - L hemiparesis
  - L hemisensory impairment
  - Dysarthria
- Alert + BP 190/85
- Background of HT / chol
Right internal carotid artery occlusion
Case Example 5

- 82 yo RH man
- Background of HT and diabetes
- 2 hour history of
  - Non-fluent speech
  - Word-finding difficulty
  - R hemiparesis
- Which blood vessel is involved?
- Which hemisphere?
- Management?
Subtle loss of grey-white differentiation in L frontal region
CT Angiogram

Occluded 2\textsuperscript{nd} branch of L MCA

Reduced collateral branches
In L MCA territory
Matched defect in the left MCA territory

Prolonged mean transit time (red)

Reduced cerebral blood flow (blue)

Reduced cerebral blood volume (blue)
Case Example 6

- 76 yo F
- Found collapsed
- Unresponsive
- Spastic quadriplegia
- No verbal output
- No gag reflex
- No facial movement
- Able to respond by blinking or with vertical eye movements
Non-Contrast CT Brain Scan

Pontine infarct
CT Angiogram

Occluded basilar artery

2 vertebral arteries join to become the basilar artery