Neurologic Emergencies: A Review for the Non-neurologist

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Assistant Professor of Neurocritical Care
UMASS Medical Center
Nothing to disclose
Outline

- Review common neurologic emergencies
  - Ischemic Stroke
  - Hemorrhagic Stroke
  - Subarachnoid Hemorrhage
- Discuss recognition, evaluation and management strategies
Stroke

- Acute onset, focal neurologic symptoms attributed to vascular abnormality
- 4th Leading cause of death
- Leading cause of disability
- Prevalence 6.6M
- $71 Billion/Yr
Stroke

Ischemic 85%

Hemorrhagic 12%

Subarachnoid 3%

Ischemic Stroke

- **Risk Factors**
  - Diabetes
  - CAD/PVD
  - Hyperlipidemia
  - Atrial Fibrillation
  - Hypertension
  - Smoking/Drugs

Primary Prevention includes management of Risks

- HTN, HPL, DM, CAD
- Smoking cessation counseling
- There is no role for aspirin
- Atrial fibrillation

Meschia et al. Guidelines for primary prevention of stroke, Stroke 2014
Ischemic Stroke

CHADS₂, CHA₂DS₂-VASc, and long-term stroke outcome in patients without atrial fibrillation. March 12, 2013 80:1009-1017; published ahead of print February 13, 2013

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Stroke risk per year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C</strong> Congestive Heart Failure</td>
<td>+1 point</td>
</tr>
<tr>
<td><strong>H</strong> Hypertension</td>
<td>+1 point</td>
</tr>
<tr>
<td><strong>A</strong> Age ≥75</td>
<td>+2 point</td>
</tr>
<tr>
<td><strong>D</strong> Diabetes</td>
<td>+1 point</td>
</tr>
<tr>
<td><strong>S</strong> Stroke/TIA History</td>
<td>+2 point</td>
</tr>
<tr>
<td><strong>V</strong> Vascular Disease</td>
<td>+1 point</td>
</tr>
<tr>
<td><strong>A</strong> Age 65-74</td>
<td>+1 point</td>
</tr>
<tr>
<td><strong>S</strong> Sex (Female)</td>
<td>+1 point</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCORE</th>
<th>% RATE PER YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>1</td>
<td>1.3%</td>
</tr>
<tr>
<td>2</td>
<td>2.2%</td>
</tr>
<tr>
<td>3</td>
<td>3.2%</td>
</tr>
<tr>
<td>4</td>
<td>4.0%</td>
</tr>
<tr>
<td>5</td>
<td>6.7%</td>
</tr>
<tr>
<td>6</td>
<td>9.8%</td>
</tr>
<tr>
<td>7</td>
<td>9.6%</td>
</tr>
<tr>
<td>8</td>
<td>6.7%</td>
</tr>
<tr>
<td>9</td>
<td>15.2%</td>
</tr>
</tbody>
</table>

## Ischemic Stroke

### HAS-BLED score

<table>
<thead>
<tr>
<th>Condition</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>H - Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>A - Abnormal renal or liver function (1 point each)</td>
<td>1 or 2</td>
</tr>
<tr>
<td>S - Stroke</td>
<td>1</td>
</tr>
<tr>
<td>B - Bleeding</td>
<td>1</td>
</tr>
<tr>
<td>L - Labile INRs</td>
<td>1</td>
</tr>
<tr>
<td>E - Elderly (&gt; 65 years)</td>
<td>1</td>
</tr>
<tr>
<td>D - Drugs or alcohol (1 point each)</td>
<td>1 or 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HAS-BLED score</th>
<th>Bleeds per 100 patient-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.13</td>
</tr>
<tr>
<td>1</td>
<td>1.02</td>
</tr>
<tr>
<td>2</td>
<td>1.88</td>
</tr>
<tr>
<td>3</td>
<td>3.74</td>
</tr>
<tr>
<td>4</td>
<td>8.70</td>
</tr>
<tr>
<td>5</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Case 1

- 47yo man with a history of smoking and no other known history who presents with R arm and leg weakness noted at 1230pm upon waking. His wife states she also noted a R facial droop
- R Hemiparesis
Ischemic Stroke

- Early Recognition

TIME = BRAIN

- Face: Does the face look uneven? Ask them to smile.
- Arm: Does one arm drift down? Ask them to raise both arms.
- Speech: Does their speech sound strange? Ask them to repeat a phrase.
- Time: Every second brain cells die. Call 9-1-1 at any sign of stroke!

Call 9-1-1 at any sign of stroke.
Middle Cerebral Artery Syndrome

R MCA distribution
• L Face, arm weakness
• L Sensory loss
• L Neglect
• R Gaze preference

L MCA distribution
• R Face, arm weakness
• R Sensory loss
• Aphasia
• R Gaze preference

Ischemic Stroke: Stroke Syndromes

Anterior Cerebral Artery Syndrome

R ACA distribution
- L leg weakness
- Cognitive abnl
- R Gaze preference

Ischemic Stroke: Stroke Syndromes

Posterior Cerebral Artery Syndrome

R PCA distribution
- L Sensory loss
- L Hemianopia

Vertebrobasilar Syndrome

Vertebrobasilar distribution

- CN findings
  - Ataxia
  - Vertigo

<table>
<thead>
<tr>
<th>Ischemic Stroke: Mimics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stroke Mimics</strong></td>
</tr>
<tr>
<td>Hypoglycemia</td>
</tr>
<tr>
<td>Migraine</td>
</tr>
<tr>
<td>Toxic/Metabolic</td>
</tr>
<tr>
<td>Infection/Sepsis</td>
</tr>
<tr>
<td>Mass lesion</td>
</tr>
<tr>
<td>Seizure</td>
</tr>
<tr>
<td>Conversion disorder</td>
</tr>
</tbody>
</table>

Hand et al. Distinguishing between stroke and mimic at the bedside, Stroke 2006
Ischemic Stroke: Mimics

- Questions to ask to determine Mimic
  - Are there vascular/stroke risks?
  - Is the nature of the symptoms (+) or (-) (loss of function or gain of function)
  - What is the onset and progression?
  - What is the duration?
  - Was there precipitating factor?
  - What are other associated symptoms?
  - Do the symptoms fit a stroke syndrome?
Ischemic Stroke: Case 1

- 47yo man with a history of smoking and no other history who presents with R arm and leg weakness noted at 1230pm.

- Vitals: BP 184/97, HR 75, RR 16 99% RA, T 37
Ischemic Stroke

- Last known well
- Brief history
- NIHSS
- Labs
Ischemic Stroke: Case 1

- Previous day 9:30pm
- Smokes 2-3ppd, Doesn’t see doctors, No medications
- Felt tired, went to bed, skipped work, woke 7:30am with right weakness back to bed and woke 12:30pm worsened

- 6 (range 0-42)
- Glucose: 238
- Creatinine 0.69
- INR 1
- Platelets 247

- NIHSS
  - Level of consciousness: alertness, Orientation, follow commands
  - Best Gaze
  - Visual Fields
  - Facial Palsy
  - Limb strength x all 4 extremities
  - Limb ataxia
  - Sensation
  - Language/aphasia
  - Dysarthria
  - Extinction/Inattention

http://nihss-english.trainingcampus.net
Ischemic Stroke

ED arrival • 1:05pm

Stroke Code • 1:09pm

NIHSS • 1:11pm

CT/CTA • 1:19, 1:27
Ischemic Stroke: CT

Examples of Stroke on CT
41yo man with acute onset R hemiparesis
Ischemic Stroke: Case 1
Ischemic Stroke

- **ED arrival**: 1:05pm
- **Stroke Code**: 1:09pm
- **NIHSS**: 1:11pm
- **CT/CTA**: 1:19, 1:27
- **tPA**: none
# Ischemic stroke

<table>
<thead>
<tr>
<th>Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis of ischemic stroke causing measurable neurological deficit.</td>
</tr>
<tr>
<td>The neurological signs should not be clearing spontaneously.</td>
</tr>
<tr>
<td>The neurological signs should not be minor and isolated.</td>
</tr>
<tr>
<td>Onset &lt; 3 hours from initiating IV tPA</td>
</tr>
<tr>
<td>Patient ≥ 18 years old</td>
</tr>
<tr>
<td>Head CT no hemorrhage or large infarct</td>
</tr>
</tbody>
</table>

Adams HP. et al AHA Guidelines Stroke 2007;38:1655-711
### Absolute Contraindications

<table>
<thead>
<tr>
<th>Absolute Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major head trauma or stroke in last 3 months</td>
</tr>
<tr>
<td>Symptoms of stroke suggestive of SAH</td>
</tr>
<tr>
<td>Blood pressure elevated, BP &gt;185/110 (may treat)</td>
</tr>
<tr>
<td>Prior history of ICH</td>
</tr>
<tr>
<td>Prior history neoplasm, AVM, aneurysm</td>
</tr>
<tr>
<td>Intracranial or spinal surgery last 3 months</td>
</tr>
<tr>
<td>Arterial puncture at noncompressible site</td>
</tr>
<tr>
<td>LP in last 7 days</td>
</tr>
<tr>
<td>Evidence of active bleeding or trauma</td>
</tr>
<tr>
<td>Platelet &lt; 100,000</td>
</tr>
<tr>
<td>Received heparin in last 48 hrs AND abnormal PTT</td>
</tr>
<tr>
<td>On coumadin AND INR &gt;1.7, PT &gt; 15</td>
</tr>
<tr>
<td>On dabigatran, rivaroxaban, or apixaban (NOACs) within 48 hours</td>
</tr>
<tr>
<td>Blood glucose abnormal, &lt;50 mg/dL (2.7 mmol/L)</td>
</tr>
<tr>
<td>Head CT large hypodensity &gt; 1/3 middle cerebral artery territory</td>
</tr>
</tbody>
</table>

### Relative Contraindications (Use caution 1 or more positive)

<table>
<thead>
<tr>
<th>Relative Contraindications (Use caution 1 or more positive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke symptoms are minor and improving rapidly</td>
</tr>
<tr>
<td>Pregnancy</td>
</tr>
<tr>
<td>Seizure and post-ictal residual</td>
</tr>
<tr>
<td>Major surgery or trauma in the last 14 days</td>
</tr>
<tr>
<td>GI or GU hemorrhage in the last 21 days</td>
</tr>
<tr>
<td>Myocardial infarction last 3 months</td>
</tr>
<tr>
<td>Additional considerations</td>
</tr>
<tr>
<td>Patient and family understand risks</td>
</tr>
<tr>
<td>Caution in treating patients with major deficits</td>
</tr>
<tr>
<td>Caution using tPA if low molecular heparin used last 24 hours</td>
</tr>
</tbody>
</table>

Adams HP. et al AHA Guidelines Stroke 2007;38:1655-711
## Ischemic Stroke

### Additional inclusion between 3 - 4.5 hrs

<table>
<thead>
<tr>
<th>NIHSS</th>
<th>Risk of Intracerebral Hemorrhage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>2-3%</td>
</tr>
<tr>
<td>11-20</td>
<td>4-5%</td>
</tr>
<tr>
<td>&gt;20</td>
<td>17%</td>
</tr>
</tbody>
</table>

Meet all criteria of < 3 hour since onset of stroke

Age ≤ 80 years of age

No anticoagulant use, regardless of INR

NIHSS ≤ 25

No combined history of prior stroke and diabetes


ECASS-3 trial. NEJM 2008;359:1317–1329
Ischemic Stroke

- ED arrival: 1:05pm
- Stroke Code: 1:09pm
- NIHSS: 1:11pm
- CT/CTA: 1:19pm, 1:27pm
- tPA: None
- IR: 2:25pm
Ischemic Stroke: Case 1
Ischemic Stroke

CT Perfusion Scan

Cerebral Blood Flow

Mean Transit Time

Time to Peak
Ischemic Stroke: Case 1
Ischemic Stroke: Case 1
Ischemic Stroke

MRI BRAIN

DWI  ADC  FLAIR
Ischemic stroke: Case 1

- LDL 116 (goal <70)
  - Lipitor 80mg
- A1C: 10.1
  - Avoid hyperglycemia
  - Endocrine CS
- Smoking cessation counseling
- Blood pressure control (SBP <140)
- Aspirin for secondary prevention
- 30d event monitor at discharge
Ischemic 85%

Hemorrhagic 12%

Subarachnoid 3%
Most common cause of nontraumatic ICH is Hypertension

Initial BP and CT findings help with determination of cause

220/126
195/100
200/90
Hemorrhagic Stroke: Case 2

- 65yo woman with a history of hypertension, noncompliant with medications presents with R arm weakness and word finding difficulties

- BP on arrival 220/126, HR 100, RR 16 99% RA
Hemorrhagic Stroke

- ED arrival
- Stroke Code
- NIHSS
- CT/CTA
Hemorrhagic Stroke: Case 2
Hemorrhagic Stroke

SPOT Sign

Wada et al. CT angiography “spot sign” predicts hematoma expansion in acute cerebral hemorrhage. Stroke 2007, 38:4
Early and rapid blood pressure control is essential

- Goal SBP <140
  - Labetalol or Hydralazine 20mg IV Q15min
  - Nicardipine infusion 2.5-15mg/hr
- Start oral medications as soon as possible

Reverse coagulopathy

- Coumadin: PCC or FFP, Vit K 10mg IV
- Dabigatran/Pradaxa: Idarucizumab/Praxabind
- Xa inhibitors: PCC
Hemorrhagic Stroke

- What about role of surgery?
  - No indication unless cerebellar origin

Hemorrhagic Stroke: Case 2

- This patient improved and was able to be discharged to rehab.
- Blood pressure control took multiple medications and she will need close followup
  - HCTZ, Labetalol, Lisinopril, Amlodipine
Stroke

- Ischemic: 85%
- Hemorrhagic: 12%
- Subarachnoid: 3%
SAH
SAH

- F>>M
- Smokers
- HTN
- Family history of aneurysms or SAH
- Cocaine use
SAH: Case 3

- 47yo woman with a history of migraine headaches, smoking and hypertension presents with severe headache that began 3h PTA.
Severe Headache

- History
- Exam
- CTh
- LP
Severe Headache

- History is key
  - Describe headache
  - Previous episode?
  - Other associated features
    - N/V, neck pain, loss of consciousness
    - Neurologic symptoms
- Brief Neurologic examination
  - Mental status, confusion, pupil changes, weakness
Severe Headache

Who to Image?
- Severe worst headache of life
- Loss of consciousness at the onset
- Acute onset headache different from usual
- Not responding to typical treatment
- Other accompanying symptoms
  - Neurologic changes
  - Meningismus
Severe Headache

Sensitivity CT for SAH

Time Since Headache Onset

3 days
1 week
2 weeks
Lumbar puncture if CTh (-)
- Must be >8h post hemorrhage
- Xanthochromia
SAH: Case 3

- Presented to ED, Severe headache though no other symptoms, thought to be migraine
- Re-presented 3d later with AMS, Confusion and drowsiness
SAH: Case 3
SAH: Case 3
SAH: Case 3
SAH

Early Complications

- Initial Rupture
  - Modify Risk: Smoking, HTN
  - Screening if family history
- Rebleed
  - Early recognition
  - Source control
  - Blood pressure control (<140)
  - Proper analgesia/sedation
- Hydrocephalus
  - Drainage of CSF
  - Hypertonic saline/Mannitol
  - Seizure prophylaxis
  - ECG, Troponins, Echo
- Takotsubo
  - Euvolemia
  - Hypertension
  - Normothermia
  - Proper analgesia/sedation
  - Screening

Late Complications

- Vasospasm
  - DCI
SAH: Case 3

External Ventricular Drain (EVD)
SAH: Case 3
SAH: Case 3

MRI BRAIN

Flair sequence
Strokes are common neurologic emergencies

Early recognition and treatment are paramount

Management strategies continue to advance

Those that survive are at high risk for further complications

Risk factor modification before and after is essential