Stroke Update

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Epidemiology of stroke 2018

- Affects nearly 800,000 people in the US annually

- Approximately 600,000 first-ever strokes and 185,000 are recurrent

- Fifth leading cause of death: 140,000

- Leading cause of long-term disability
Epidemiology of stroke 2018

- Someone has a stroke every 40 seconds
- Stroke kills someone every 4 minutes
- 1 of every 20 deaths in the US
- From 2004 to 2014 stroke death rate decreased by 28.7\% and the total number decreased by 11.3\%
- Stroke death declines have stalled since 2013
- Stroke death rates have increased among Hispanics
Epidemiology of stroke 2018

The decline in stroke deaths has **slowed** since 2013.

Stroke death declines have **STALLED** in 3 out of every 4 states.

DECLINES HAVE
- **Continued** = death rates continued to decrease steadily from 2000-2015 in adults 35 years and older
- **Slowed** = the decrease in death rates slowed down over time
- **Reversed** = the death rates reversed from decreasing to increasing
Risk Factors

- Smoking
- Physical inactivity
- Nutrition
- Obesity/Overweight
- Cholesterol
- High Blood Pressure
- Diabetes Mellitus
- Age (note that 34 pct are less than 65)
Stroke

- Focal neurological deficit caused by cerebrovascular event lasting at least 24 hours; usually of sudden onset
  - Ischemia: 80-90% (thrombosis, embolism, hypotension)
  - Hemorrhage: 10-20% (subarachnoid, intracerebral)
Type of strokes

A hemorrhagic stroke occurs when a blood vessel bursts within the brain.

An ischemic stroke occurs when a blood clot blocks the blood flow in an artery within the brain.
TIA

- Focal neurological deficit caused by transient ischemia and resolving completely within 24 hours
- MRI changes in 30-40 pct of cases
- 10 – 20 pct will have a stroke within 3 months
Approach to Treatment of Stroke

- Does the patient have symptoms and signs consistent with a cerebrovascular event? (DIAGNOSIS)

- What can be done to limit or reverse the damage? (ACUTE TREATMENT)

- What can be done to reduce the risk of future events? (PREVENTION)

- What can we do to augment plasticity? (RECOVERY)
Diagnosis

- Based on history and physical exam
- Cohort of symptoms/signs referable to a vascular distribution
- No helpful lab tests, imaging usually normal acutely
- Non-contrast head CT: hemorrhage vs. ischemia
  - Role of functional imaging for diagnosis?
    - MRA, diffusion weighted MRI +/- perfusion MRI
    - CT angiography, CT perfusion
Stroke Mimics

- Seizure with Todd’s paralysis
- Hypo- or hyperglycemia
- Complicated migraine
- Mass lesion
- Reversible leukoencephalopathy
- Infection, toxic/metabolic problem superimposed upon a previous deficit
- Conversion disorder
- Other
- Note that up to 30% of patients treated with IVtPA were mimics
Stroke Masquerades

- Altered mental status
- TIA
- Vertigo
- Movement disorder
- Pain syndromes
Accurate Dx vs Metrics

- What is acceptable miss rate
- What is acceptable complication rate
Diagnostic approach to stroke

- What
- How
- Why
The Most Frequent Sites of Arterial and Cardiac Abnormalities Causing Ischemic Stroke

Intracranial Atherosclerosis
Carotid Plaque With Arteriogenic Emboli
Aortic Arch Plaque
Cardiogenic Emboli
Penetrating Artery Disease
Flow Reducing Carotid Stenosis
Atrial Fibrillation
Valve Disease
Left Ventricular Thrombi

Therapeutic approach to stroke

- Limiting cellular injury
- Reperfusion
- Systemic complication
- Neurological complications
- Rehabilitation
Pathophysiology

- Gradient of blood flow reduction:
  - Penumbra: injured but potentially salvageable tissue

- Mechanisms of ischemic injury in penumbra:
  - Tissue acidosis
  - Excitotoxicity
  - Lipid catabolism/arachadonic acid cascade
  - Free radicals
  - Programmed cell death
Reperfusion

- Blood pressure management
- Thrombus removal
Systemic Complications

- Aspiration (feeding tube, intubation)
- DVT (subQ Heparin and sequential compression devices)
- Infection (leading cause of late death)
- Skin breakdown (repositioning, inflating mattress)
- Glucose management (an evolving story)
- Malnutrition (swallow eval, feeding tube)
- Debilitation (early mobilization and therapy)
- Other medical co-morbidities
Neurologic Complications

- Increased intracranial pressure
  - Hemorrhagic transformation
  - Cytotoxic edema

- Edema maximal at 36-72 hours, usually manifests as decline in level of consciousness

- Herniation is leading cause of death in acute setting (fatal arrhythmia is second)

- HEMICRANIECTOMY – follow the protocol
Rehabilitation
Use of tPA
NINDS trials Dec 1995 NEJM

- 624 patients over 18
- Double-blinded placebo controlled
- Treated within 3hrs (1/2-90min, ½-90 to 180min)
- FDA approved in 1996
Inclusion and Exclusion Criteria

**Inclusion**

- Stroke within the **first three hours** after symptom onset
  - *If not witnessed, onset time was when the patient was last seen normal*
- Non-contrast head CT without evidence of hemorrhage (or mass effect, edema)

**Exclusions**

- Stroke or head trauma within 3 months
- Major surgery within 14 days
- Any history of intracranial hemorrhage (ICH)
- Symptoms suggestive of subarachnoid hemorrhage (SAH)
- Systolic BP > 185 mmHg
- Diastolic BP > 110 mmHg
- Patients were also excluded if aggressive measures were required to lower the blood pressure to within specified limits
Exclusions

- Rapidly improving or minor symptoms
- Gastrointestinal hemorrhage within 21 days
- Urinary tract hemorrhage within 21 days
- Arterial puncture at a noncompressable site within 7 days
- Seizures at the onset of stroke
- Patients taking oral anticoagulants
Exclusions

- Heparin within 48 hours AND an elevated PTT
- Patients with an elevated PT/INR > 1.6
  - Partial thromboplastin time = PTT; prothrombin time = PT, International Normalized Ratio = INR
  - All of these are laboratory measures of anticoagulation related to heparin or coumadin use
- Platelet count below $100 \times 10^9/L$
- Blood glucose < 50 mg/dl
- Blood glucose > 400 mg/dl
BOTTOM LINE: Appropriate patients without contraindications should be treated at 0-3 hours, as per the NINDS study protocol.
AHA/ASA new statement 2016

- Expanding the use of IV tPA
- Include older patients >80
- Include severe strokes NIHSS >25 (<3hrs)
- Include mild but disabling strokes (no exclusion)
- Time 3-4.5 hrs (<80, no dm+htn, NIHSS<25)
- Rapidly improving symptoms
- Over 80 still shows better chance of being independent at 3 months
- Warfarin use (INR<1.7) but not other anti coagulants
Other Concerns

- Rapidly improving but still with moderate impairment
- Seizures at onset
- Psychogenic/mimics
The new time window 3-4.5 hrs

- Carefully selected patients
- Age over 80 included
- Taking Warfarin but less than 1.7 INR
- Uncertainty if stroke is severe NIHSS >25
Evolving Time Window

- ECASS III: exclude age > 80, NIHSS > 25, diabetics with previous stroke; 3.0-4.5 hrs after onset

- Benefit for thrombolysis!

- And beyond 4.5 hours?
  - Data for endovascular therapy out 6-8 hours

- CALL THE STROKE TEAM OUT TO 8 HOURS
Secondary prevention of strokes

- Prevent medical complications

- Risk factor modification
  - Especially treatments for HTN, DM, high cholesterol, and smoking cessation

- Medical or surgical therapy
  - Must know mechanism of stroke
  - Echo to look for cardiac source
  - Imaging to look for carotid source
  - Otherwise, standard anti-platelet therapy
## Risk factor modification

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<thead>
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<th>Nonmodifiable</th>
<th>Modifiable</th>
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<td>Age</td>
<td>HTN</td>
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<tr>
<td>Race</td>
<td>DM</td>
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<tr>
<td>Gender</td>
<td>TIA's/previous strokes ?</td>
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<tr>
<td>Family history</td>
<td>Cardiac disease (?PFO)</td>
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<td>Atrial fibrillation</td>
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<td>Hypercholesterolemia</td>
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<td>Hypercoaguable states</td>
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<td>Obesity</td>
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<td>Alcohol/drugs</td>
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<td>Oral contraceptives</td>
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<td>Migraine headaches</td>
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<td>Cigarette smoking</td>
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<td>Autoimmune/inflammatory disease</td>
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<td>Homocysteine</td>
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<td>Sleep apnea</td>
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Stroke Recovery

- Rehabilitation
  - Benefit is well established (?)
  - Mechanism by which this facilitates recovery is unclear
  - Begin OT, PT, Speech Therapy immediately
  - Recovery maximal in first weeks, months; can continue INFINITELY (?)
Stroke Recovery: Rehabilitation

- What is remarkable is how much we don’t know
  - What predicts recovery?
  - What prevents recovery?
  - What dose of rehab to administer?
  - What we can do besides rehab?
  - How to measure function/recovery?
What’s needed to decrease stroke deaths?

RISK FACTORS FOR STROKE
Knowing and managing your risks for stroke are key.

- HIGH BLOOD PRESSURE, a leading cause of STROKE
- TOBACCO USE
- DIABETES
- HIGH CHOLESTEROL
- OBESITY & PHYSICAL INACTIVITY

Recognize the signs of stroke F.A.S.T.

- FACE: Ask the person to smile. Does one side droop?
- ARMS: Ask the person to raise both arms. Does one arm drift downwards?
- SPEECH: Ask the person to repeat a simple sentence. Are the words slurred?
- TIME: If the person shows any of these symptoms, call 911 immediately.

Learning the signs of a stroke can HELP SAVE LIVES

SOURCE: Adapted from the Cincinnati Pre-hospital Stroke Scale, University of Cincinnati, 1997.

Stroke Systems of Care

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<th>Community</th>
<th>Pre-Hospital</th>
<th>Hospital</th>
<th>Post-Hospital</th>
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<td>Detection</td>
<td>Delivery</td>
<td>Decision</td>
<td>Discharge Coordination</td>
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<td>Everyone knows the signs of stroke and the need to call 911 immediately.</td>
<td>Fast emergency medical services (EMS) transport to the hospital with pre-hospital notification that they are on the way.</td>
<td>Identify stroke, quickly decide on and provide appropriate treatment.</td>
<td>Patient rehabilitates, recovers, and returns home.</td>
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The STROKE SYSTEMS OF CARE depends on coordinated partnerships among health systems and professionals, smooth transitions from one care setting to the next, data-driven quality improvement programs that provide the best care to every patient every time, consistent hospital discharge processes with all of the patient’s healthcare professionals, and continued actions that improve patient care and save lives.
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