The Stroke Center of the Future: What Does This Look Like?

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Conflicts of Interest

- **Consultant**
  - Abbott Vascular (non-compensated)
  - American Genomics, Inc
  - Astra Zeneca Pharmaceuticals, Inc
  - Boston Scientific (non-compensated)
  - Cordis Corporation (non-compensated)
  - Covidien (non-compensated)
  - Ekos Corporation (DSMB)
  - Medtronic (non-compensated)
  - Micell, Incorporated
  - Primacea
  - Trivascular, Inc.

- **Equity**
  - Access Closure, Inc
  - Embolitech, Inc
  - Hotspur, Inc
  - Icon Interventional, Inc
  - I.C.Sciences, Inc
  - Janacare, Inc
  - MC10
  - Northwind Medical, Inc.
  - PQ Bypass, Inc
  - Primacea
  - Sadra Medical
  - Sano V, Inc.
  - Vascular Therapies, Inc

- **Board Member**
  - VIVA Physicians (Not For Profit 501(c) 3 Organization)
    - www.vivapvd.com

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Stroke is a Big Deal

20% of:
- total resting oxygen
- total resting blood flow
And this is what it is all about...
The Stroke Mortality Map

Circulation 2012;125:e2-e220
Stroke Stats

• Fourth leading cause of death in the US
  – 134,138 deaths in 2008
  – 1 out of 18 deaths due to stroke in US
    • One American dies of a stroke every 4 minutes

• Most common cause of adult disability
  – 31% of stroke survivors receive outpatient rehabilitation
    • 50% with some hemiparesis
    • 30% unable to walk without some assistance
    • 26% dependent in ADLs
    • 35% depressed
    • 26% institutionalized in a nursing home
Stroke Costs

• Total cost of stroke care 2005-2050 (in 2005 dollars)

$1.52 Trillion---Non-Hispanic Whites
$313 Billion---Hispanics
$379 Billion---Blacks
The Basis of Acute Stroke Therapy

- The "recanalization hypothesis"
  - i.e. reopening of occluded vessels improves clinical outcome in acute ischemic stroke through reperfusion and salvage of threatened tissues.

- Several biologic factors weaken the relationship of recanalization to outcome in acute ischemic stroke patients:
  - too late
  - collateral circulation
  - reperfusion injury
  - no-reflow phenomenon
It is estimated that the typical stroke patient loses 2 million neurons per minute in which stroke is untreated.

### Estimated Pace of Neural Circuitry Loss in Typical Large Vessel, Supratentorial Acute Ischemic Stroke

<table>
<thead>
<tr>
<th></th>
<th>Neurons Lost</th>
<th>Synapses Lost</th>
<th>Myelinated Fibers Lost</th>
<th>Accelerated Aging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Stroke</td>
<td>1.2 billion</td>
<td>8.3 trillion</td>
<td>7140 km/4470 miles</td>
<td>36 y</td>
</tr>
<tr>
<td>Per Hour</td>
<td>120 million</td>
<td>830 billion</td>
<td>714 km/447 miles</td>
<td>3.6 y</td>
</tr>
<tr>
<td><strong>Per Minute</strong></td>
<td><strong>1.9 million</strong></td>
<td><strong>14 billion</strong></td>
<td><strong>12 km/7.5 miles</strong></td>
<td><strong>3.1 wk</strong></td>
</tr>
<tr>
<td>Per Second</td>
<td>32 000</td>
<td>230 million</td>
<td>200 meters/218 yards</td>
<td>8.7 h</td>
</tr>
</tbody>
</table>
Schematic Timeline of Acute Stroke Therapy

So, How Do We Accomplish This?

• The Stroke Center of the Future
  – Mandatory Components for Success
    • Multidisciplinary
    • The system must work FAST
      – Door ➔ ED ➔ CT/CTA/Perfusion Scan ➔ Needle ➔
        (?) Cooling to 33-degrees C on the way
      – IV rtPA within 4.5 hour window
      – When to proceed to IAT?
    • Center-specific prospective outcomes measurements
The Stroke Team

• Physicians
  – ED
  – Stroke Neurology
  – Neurosurgery
  – Neurointervention
  – Trainees (multiple specialties)

• Nursing
  – ED
  – Stroke Neuro ICU
  – Intervention

• Technology
  – ED Radiology
  – Intervention

• Critical Support
  – Pharmacy
  – Research Coordinator
  – Social Service/Family
You Must Have the Protocols…

<table>
<thead>
<tr>
<th>Role</th>
<th>Task</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER Resident</td>
<td>Page ED2CT (stroke, research, rads fellows)</td>
<td>Emergency Department</td>
</tr>
<tr>
<td>ER Nurse</td>
<td>Get transport equipment ready</td>
<td>Emergency Department</td>
</tr>
<tr>
<td></td>
<td>IV access, labs, vitals, EKG</td>
<td>CT Scanner</td>
</tr>
<tr>
<td>Neuro Resident</td>
<td>Mobilize, obtain pertinent medical history, confirm scans ordered</td>
<td>CT Scanner</td>
</tr>
<tr>
<td></td>
<td>by ED/rads secretary</td>
<td>MRI Scanner</td>
</tr>
<tr>
<td>Stroke Fellow</td>
<td>Mobilize upon ED-CT page, initiate consult, establish LSW, NIHSS</td>
<td>CT Scanner</td>
</tr>
<tr>
<td>INR Fellow</td>
<td>Mobilize, activate technologist</td>
<td>CT Scanner</td>
</tr>
<tr>
<td>INR Technologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anesthesia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Angio:**
- Transfer patient to angio suite

**CT Scanner:**
- Transfer patient to MRI scanner
- Help monitor time lapsed
- Review scans
- Stroke attending assists with decision-making
- Decision to treat, transfer patient to angio suite
- NeuroR attending assists with decision-making
- Update tech, prep angio suite

**MRI Scanner:**
- Page acute stroke attending
- Review scans
- Obtain written consent for IAT, alert attending
- Continue set-up

**Emergency Department:**
- Get transport equipment ready
- IV access, labs, vitals, EKG
- Confirm healthcare proxy, complete MRI checklist
- Mobilize, obtain pertinent medical history, confirm scans ordered by ED/rads secretary
- Page INR fellow based on LVO prediction rule
- Review scans
- Stroke attending assists with decision-making
- Decision to treat, transfer patient to angio suite
- NeuroR attending assists with decision-making
- Update tech, prep angio suite

**Massachusetts General Hospital Cardiovascular Research Foundation**
The Stroke Center of the Future

Basic Care: Assess/Identify/Stabilize

Acute Stroke Capable Hospitals
Emergent CT Scanner/IV rtPA

Primary Stroke Center:
Stroke Service/Coordinator/Continuity of Care

Comprehensive Stroke Center:
Neurosurgeon/Neuroendovascular On Site; Full Spectrum Care
Jacobs Institute, Buffalo, New York
The Stroke Center of the Future

What is Required to Build This?

- Broad expertise across all specialties
- Willingness to break down silos
- Pool finances (sorry, but I don’t see this working any other way)
- Institutional Intestinal Fortitude
- A philanthropist who is a believer
- A commitment to prospective outcomes research
- Excellent planning
- Speed is at the center of the program