The Role of Different Types of Stroke Centers in a Stroke System of Care

Mark J. Alberts, MD
Professor of Neurology
Northwestern University Medical School
Northwestern Memorial Hospital
Chicago, Illinois, USA

What is a Stroke System of Care?

- A comprehensive, diverse, longitudinal system that addresses all aspects of stroke care in an organized and coordinated manner
- Spans the spectrum of stroke care from primary prevention, calling 9-1-1, acute care, secondary prevention, rehabilitation, return to the community
- As with any system, it is only as strong as its weakest link
- This talk will focus on the acute care aspects
- But all elements are important
- Will be addressed in an upcoming AHA/ASA publication

Presenter Disclosure Information

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UNLABELED/UNAPPROVED USES DISCLOSURE:
None
EMS Plays a Key Role in a Stroke System

- Is typically the first medical professionals with direct patient contact
- Their initial assessments, actions, treatments, and decisions will have significant consequences in the patient’s subsequent care
- Their role in patient triage, diversion, and routing cannot be under-estimated

Characteristics of Different Stroke Centers

- Comprehensive Stroke Center
  - Academic Medical Center
  - Tertiary Care facility
- Primary Stroke Center
  - Wide range of hospitals; standard stroke care; stroke unit; use TPA
- Acute Stroke Ready Hospital
  - Rural hospitals; basic care; drip and ship; use tele-technologies
Update on CSCs and Acute Stroke Care

Mark J. Alberts, MD

Numbers of Various Types of Stroke Centers

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
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<tbody>
<tr>
<td>Comprehensive Stroke Center</td>
<td>75 to 250 total</td>
</tr>
<tr>
<td>Primary Stroke Center</td>
<td>Final count 1000-1300</td>
</tr>
<tr>
<td>Acute Stroke Ready Hospital</td>
<td>Perhaps 1200-1800</td>
</tr>
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</table>

> 5000 total acute care hospitals in the U.S.

Stroke and National Care Paradigms

- CMS is set to introduce 2 new national care measures related to stroke in 2013
- These apply to all stroke patients in any hospital
  1. 30 day all cause mortality for ischemic stroke
  2. 30 day re-admission rates after stroke discharge

- These results will be publicly available and will almost certainly affect reimbursement rates
- CMS will likely **not** pay for re-admissions

ASRH: Concept and Targets

- Many stroke patients are in small urban, suburban, and rural areas
- Many have no access to a PSC or CSC
- Defining a sub-PSC tier would be helpful for several reasons:
  - Better define which hospitals in a specific area have some capabilities to care for acute stroke patients
  - Help guide EMS about where to take patients
  - Provide information to patients about where to go if a stroke occurs
  - ASRHs are referred to in some state laws but without specific elements and definitions

- **The intent is for an ASRH to be some distance away from a PSC or CSC, not across the street**
Key Elements of the ASRH

- Acute Stroke Team
- Stroke Protocols
- EMS
- ED
- Laboratory Testing
- Rapid Imaging
- Neurosurgical Services
- Stroke Unit (not needed since typically no admissions)
- Transfer agreements to a PSC or CSC
- Telemedicine links to a PSC or CSC
- Medical Leadership and Administrative Support!!!
Tele-technologies at an ASRH

- Video conference (VC) or teleconference (TC) for screening for TPA and other acute therapies
  - VC generally more supported and reliable
  - TC for screening and other consultative cases
- Tele-radiology for interpretation of CT/MRI
  - Obviously have to see the images
  - ACR has published technical aspects
  - System must be FDA approved (several already available)
- Must have signed agreements with a PSC or CSC for these services on a 24/7 basis

Primary Stroke Centers

- About 950 PSCs currently certified by TJC
  - Perhaps another 100 or so certified by another organization
- Mostly urban, suburban
- Provide organized care in most states and regions
- Some academic, some not
- Typically have 300-400 stroke admissions per year
  - Some up to 800-1000/yr

Updated PSC Recommendations

- MRI with diffusion available for stroke patients
- Vascular imaging for stroke patients
  - MRA of head/neck
  - CTA head/neck
  - Doppler alone not acceptable
- Cardiac imaging
  - TTE, TEE, or cardiac MRI
- Stroke Unit monitoring protocols
  - Multichannel telemetry
  - Clinical monitoring plans
  - Who to call/when to call plans
- Begin rehabilitation efforts ASAP
- Certification by an independent organization

Alberts et al. Stroke, 2011
NY State PSC Study

- 30,947 patients with acute ischemic stroke
- 2005-2006
- One year follow-up
- 15,297 admitted to a designated stroke center (PSC)
- Used 39,000 and 40,000 patients with GI hemorrhage and MI as internal controls

NY State Study
Mortality Outcomes

<table>
<thead>
<tr>
<th>No. (%)</th>
<th>1d</th>
<th>7d</th>
<th>30d</th>
<th>1y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designated Stroke Center (n = 15,257)</td>
<td>90 (0.6)</td>
<td>665 (4.3)</td>
<td>1543 (10.1)</td>
<td>3412 (22.3)</td>
</tr>
<tr>
<td>Nondesignated Hospital (n = 15,665)</td>
<td>134 (0.8)</td>
<td>812 (5.2)</td>
<td>1951 (12.3)</td>
<td>4061 (26.0)</td>
</tr>
<tr>
<td>Adjusted Mortality Difference [95% CI]</td>
<td>-0.3 [-0.6 to -0.0]</td>
<td>-1.3 [-2.1 to -0.6]</td>
<td>-2.5 [-3.0 to -1.4] &lt;0.01</td>
<td>-3.0 [-4.1 to -1.9] &lt;0.01</td>
</tr>
<tr>
<td>P Value</td>
<td>.04</td>
<td>.001</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
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</tbody>
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Impact of Reduced Death Rates for Stroke

- Stroke is the 4th leading of death in the US and the 2nd leading cause of death globally
- 2% to 3% reduction in deaths in US means
  - 16,000 to 24,000 fewer deaths in the US
- Globally this means 320,000 to 480,000 fewer stroke deaths each year
- There are very few medical interventions that reduce deaths
  - Trauma centers DO
  - Coronary stenting vs angioplasty DOES NOT
  - CEA vs medical therapy DOES NOT
Hypotheses

- Hospitals certified as Primary Stroke Centers (PSCs) would increase the use of IV TPA in eligible patients
- The longer a hospital was a certified PSC, the rate of IV TPA administration would increase

Methods

- We analyzed data from PSCs certified by The Joint Commission (TJC) from 2008-2011
- Rates of IV TPA use in eligible patients (ischemic strokes, presentation within 2 hr. of Sx onset/last known normal, no contraindications to TPA therapy)
- Analyzed number of certification cycles, hospital setting, and teaching status

Results

- 34,909 eligible patients at 842 PSCs were identified
- 455 teaching hospitals; 367 non-teaching
- 783 urban; 39 rural
- 1 cycle = 278
- 2 cycles = 235
- 3 cycles = 246
- 4 cycles = 83

Alberts et al, presented at ISC, February 2011, New Orleans
The overall rate of TPA use increased from 79.4% in 2008 to 83.5% in 2011 (p < 0.001).

Overall 10% absolute increase in rate of TPA use between 1 and 4 certification cycles (p < 0.004).

Overall the differences have narrowed over time.
IV TPA Use by Hospital Characteristics

- TPA use was higher at teaching hospitals vs non-teaching hospitals, though the actual numbers are quite close:
  - 82.2% Teaching
  - 79.0% Non-teaching (p < 0.001)
- Urban hospitals had higher rates of TPA use compared to non-urban hospitals
  - 81.3% Urban
  - 72.5 Non-urban (p < 0.001)

TPA Use at Teaching vs Non-Teaching PSCs

PSCs Achieve High Rates of Compliance with other Care Paradigms

* = statistically significant
Alberts et al, ISC 2011
PERFECT Study-Finland

- Compared outcomes among patients admitted to different types of hospitals
- Used BAC criteria for PSC and CSC
- Adjusted for baseline differences

CSC = 20,045  PSC = 10,749  GH = 30,891

<table>
<thead>
<tr>
<th>Outcome adjusted for patient demographics, OR (95% CI)</th>
<th>CSC</th>
<th>PSC</th>
<th>GH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-fatality by 1 year</td>
<td>0.84 (0.80-0.89)</td>
<td>0.89 (0.84-0.94)</td>
<td>1</td>
</tr>
<tr>
<td>Institutional care at 1 year</td>
<td>0.87 (0.82-0.93)</td>
<td>0.89 (0.83-0.96)</td>
<td>1</td>
</tr>
<tr>
<td>Home at 1 year</td>
<td>1.22 (1.17-1.28)</td>
<td>1.16 (1.10-1.23)</td>
<td>1</td>
</tr>
</tbody>
</table>

Meretoja et al, Stroke, 2010

Patient Types at a Comprehensive Stroke Center

- Large complex ischemic strokes
  - Endovascular therapy
  - Hemicraniectiony
  - Systemic disease with multi-organ involvement
  - High ICP
  - Cryptogenic etiology
- Intracerebral hemorrhage
  - ICU level care
  - Neurosurgical interventions
- Subarachnoid hemorrhage
  - ICU level care
  - Endovascular and neurosurgical therapies
  - Vasospasm treatments

Key Elements of a Comprehensive Stroke Center

- All components of a Primary Stroke Center, plus
  - Availability of advanced imaging techniques
    - MRA/MRA, CTA, DSA, TCD
  - Availability of personnel trained in vascular neurology, neurosurgery, endovascular techniques
  - 24/7 availability of personnel, imaging, OR, and endovascular facilities (i.e., a hospital cannot be a CSC from just 8AM to 5PM)
  - ICU/Neuroscience ICU
  - Stroke registry
  - Experience and expertise treating patients with large strokes, ICH, SAH

DSA = digital subtraction angiography; TCD = transcranial Doppler.
**Key Personnel at a CSC**

- **CSC Director**—most likely an MD with advanced training in vascular neurology
- **Neurosurgeon(s)** with training in vascular neurosurgery
- **Endovascular expertise** for lytic/mechanical therapy, coiling, stenting, etc.
- **Intensivist/Neuro-intensive** for ICU staffing
- **Nursing personnel** for stroke unit, ICU/NICU, endovascular, OR, etc.
- **Advanced practice nurses** for stroke registry, education, referrals
- **Therapists and pharmacists**—patient care and research studies

**CSC Requirements**

- MRI available for stroke patients; 24/7
- MRI with diffusion 24/7
- Vascular imaging for stroke patients
  - MRA of head/neck 24/7
  - CTA head/neck 24/7
  - TCD
  - Carotid Doppler
  - Catheter angiography 24/7

**CSC must have NICU beds**

- MDs and nurses with experience and expertise caring for complex stroke patients
  - Includes ischemic strokes, ICH, SAH
  - 24/7 staffing and capability
- **Does this need to be a separate NICU?**
  - probably not
- **Does this require a certified neuro-intensive?**
  - Unlikely
- **Can this requirement be met by a few NICU beds in a larger MICU/SICU with a general intensivist/pulmonologist/anesthesiologist?**
  - Perhaps
**CSC-Volume Requirements**

- The CSC will care for at least 20 subarachnoid hemorrhage patients per year.
- The CSC will perform at least 10 craniotomy surgeries for aneurysm per year.
- The CSC will perform at least 15 endovascular coiling surgeries (either acute or elective) for aneurysm per year.
  
  *Some of these may be revised based on concerns from NSGY*
- The CSC will administer IV tPA to at least 25 eligible patients per year.
  
  - Telemedicine cases are counted

**Research at a CSC**

- This is a new, unique requirement
- Based on two factors:
  1. This should be part of the mission of a CSC
  2. Participation in research generally improves outcomes
- Must be an IRB-approved project
  
  - This is meant to avoid data-base and registry type projects
- Research must be patient-oriented
  
  - This is meant to exclude animal focused projects which may not impact patient care

**Telemedicine at a CSC**

- Most CSCs will have some type of telemedicine arrangement
  
  - Telephone consults
  - Full video conferencing with radiology feeds
  - Remote robotic interactions
- Link CSC to PSCs and ASRHs in their network
- Pre-arranged consultations and transfers
  
  - Specify vendors, logistical issues, platforms, reimbursement, legal issues
  - Decide who to transfer and how to transfer
Outcomes at a CSC: Finland Study

<table>
<thead>
<tr>
<th>Table 4. Outcome of Finnish Patients With Ischemic Stroke</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Unassisted outcome, no. (%)</td>
</tr>
<tr>
<td>Case fatality by 1 year</td>
</tr>
<tr>
<td>Institutional care by 1 year</td>
</tr>
<tr>
<td>Home by 1 year</td>
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<tr>
<td>Outcome adjusted for patient demographics, 95% CI</td>
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Steps in Transforming From a PSC to a CSC

- **Key PSC elements**
  - Stroke Unit; no NICU
  - MRI, MRA, CTA
  - NSGY within 2 hours
  - No endovascular
  - No vascular neurology
  - No specific volume requirements
  - No research requirement

- **Key CSC elements**
  - Stroke Unit + NICU
  - MRI, CTA, MRA, angiography available 24/7
  - NSGY 24/7
  - Endovascular 24/7
  - Vascular neurology 24/7
  - Specific volume requirements
  - Research requirement

Growth from a PSC to CSC: Key Questions

- Does my hospital have the case volume to support the programs and investments and meet TJC requirements?
  - A large focus of CSCS is on ICH, SAH; these make up about 15% to 20% of all strokes

- Can my hospital make the financial commitment to become a CSC?
  - Hiring new personnel
  - Dedicated endovascular suites
  - NSGY programs
  - NICU programs
  - 24/7 coverage needed in many areas
Guiding Principle # 1
If all are close, go to the highest level Stroke Center initially.

Why?
- We do not know the type of stroke
- Patients can deteriorate
- Unclear what tests and treatments will be needed.

Guiding Principle # 2
Time is more important than distance, because time is brain.

Factors to consider include:
- Weather
- Traffic
- Local geography
- Mode of transportation
By-passing Hospitals

Guiding Principle # 3
To make the best decision, personnel must know the actual capabilities of their local hospitals as well as the EMS system.
- Not every hospital that claims to be a PSC or CSC will have those capabilities
- EMS triage and routing skills may vary by city and region
- All politics are local!!!

EMS Field Triage and By-Pass

Final Principle
1. Avoid by-passing another hospital (PSC, CSC) if that will add more than 15-20 minutes of transportation time
2. This time is used for many other field transportation systems
3. Exception would be some compelling reason to by-pass lower level facility
   1. High likelihood they will need a CSC level facility
Conclusions

- The Stroke Center care paradigm ensures that patients will receive the proper level of care in each case.
- Becoming a CSC will involve a significant investment for some hospitals, but will provide benefits for patients and the hospitals.
- A Stroke System of Care will promote a flexible system that can adapt and fit a variety of regional and geographic scenarios.
- Improved outcomes will reduce the financial burdens on government and health care systems.