Organization of Stroke Care: Implications of Recent Advances

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Background

- Revolutionary changes in acute stroke care
- Lack of sufficient resources to adequately manage these patients
- Strong need for triage protocols and management criteria to deal with expected volume increases
Stent-Retriever Thrombectomy after Intravenous t-PA vs. t-PA Alone in Stroke


Thrombectomy within 8 Hours after Symptom Onset in Ischemic Stroke

# Stent Retriever Trial Summary

<table>
<thead>
<tr>
<th>Trial</th>
<th>n</th>
<th>Tx t Time (h)</th>
<th>NIHSS: IA group</th>
<th>Age</th>
<th>Imaging Selection</th>
<th>stroke to TPA</th>
<th>Stroke to groin</th>
<th>90d mRS &lt;3</th>
<th>control</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRCLEAN</td>
<td>500</td>
<td>6</td>
<td>17</td>
<td>66</td>
<td>No</td>
<td>85’</td>
<td>260’</td>
<td>33%</td>
<td>19%</td>
</tr>
<tr>
<td>REVASCAT</td>
<td>206</td>
<td>8</td>
<td>17</td>
<td>66</td>
<td>Yes, CTA</td>
<td>117’</td>
<td>223’</td>
<td>44%</td>
<td>28%</td>
</tr>
<tr>
<td>ESCAPE IA</td>
<td>315</td>
<td>12</td>
<td>16</td>
<td>71</td>
<td>Yes, CTA</td>
<td>110’</td>
<td>186’</td>
<td>53%</td>
<td>29%</td>
</tr>
<tr>
<td>SWIFT-PRIME</td>
<td>196</td>
<td>4.5</td>
<td>17</td>
<td>65</td>
<td>Yes, CTP (some CTA)</td>
<td>110’</td>
<td>224’</td>
<td>60%</td>
<td>36%</td>
</tr>
<tr>
<td>Extend IA</td>
<td>70</td>
<td>6</td>
<td>17</td>
<td>69</td>
<td>Yes, CTP</td>
<td>127’</td>
<td>210’</td>
<td>70%</td>
<td>41%</td>
</tr>
</tbody>
</table>

*NEJM Jan 2015*  
*NEJM Feb 11 2015*  
*NEJM Apr 17 2015*
CPMC Data: 2012-2014

- >150 patients
  - Largest cohort in N California
- NIHSS=15 (vs. 16.5 in studies)
- Time to tx 452’ (vs avg 227 in trials)
- ~63% mRS <3 (~same as best trials)
- Uses CTA/CTP guided therapy
Stentretriever Trials Implications

- Tremendous advance relative to prior tx
  - Level 1A evidence
- Treatment **mandatory** (like PCI for AMI)
- Large number of candidate patients (>30%)
- Few guidelines on how to triage and treat patients within this new paradigm
Organizing Stroke Care: Lessons from Cardiology?

- Vast network of catheterization centers developed over decades
  - Individual hospital driven
- High number of specialists
  - Not derived from organized planning
- Gradual benchmark and guideline creation

**Drawbacks:** Slow development, costly, high resource utilization
Stroke System Goals

• Leverage lessons from cardiology
• Leapfrog gradual cardiac evolution
• Implement optimal system realizing current (limited) resources
• Create organized system rather than disorganized individual initiative
Important Issues

• Resource utilization
  – Optimal imaging protocol
  – Ideal triage approach
  – Best transfer methodology

• Personnel
  – Availability/Recruitment
  – Quality (credentialing)

• Optimization
  – Quality improvement
  – Research
Local Site Issues to Address

- Triage approach?
  - Screening/Imaging protocol?
  - Time window?
- Available referral centers?
  - Alternative providers?
- Transfer capability?
  - Speed/efficiency/availability?
  - Air vs. ground?
Tertiary Center Issues to Address

• Patient triage?
  – Coordination with local as well as other tertiary sites?
  – Imaging protocol?
  – Time window?

• Transfer system organization?
  – System-wide approach?

• Manpower adequacy? Quality?

• Hospital/Cath lab capacity?

• Cost?
CPMC Model

• Hub and Spoke system with telemedicine and imaging access
  – Permits rapid triage and framework for communication
    • Does NOT require compatible EHR
    • Can work without telemedicine
• Highly trained neuro specialists
  – All board certified in neurocritical care, vascular neurology or both
CPMC Stroke Network

- CPMC Telemedicine Sites (n~20)
- Sutter Network Sites (n=29)
- Other Frequently Referring Sites (n=43)
CTA/CTP all r/o acute stroke cases ≤12h
- some sites ≤8h depending on distance
- CTA only if minor (non disabling) sx
- Consult Neurologist for decision assistance

CTA/CTP if 6-24h, AND NIHSS≥10
- If MCA occlusion: enroll in DAWN trial
- If 6-24h and NOT DAWN candidate treatment case by case
  - Highly dependent on CTA/CTP results
DAWN SELECTED IMPORTANT INCLUSION AND EXCLUSION CRITERIA

INCLUSION:
• NIHSS ≥10; 6-24h from last known well
• Occlusion of the intracranial ICA or MCA M1 (proximal MCA)
• In hospital or POST surgery stroke NOT excluded

EXCLUSION:
• Head injury ≤ 90d with deficit
• Major hemorrhage ≤ 30 days
• Glucose <50mg/dL or >400mg/dL
• Creatinine >3.0 mg/dL (if on dialysis no limit)
• Coagulation abnl (i.e.: INR > 3.0 or PTT > 3 times nl (NOAC ok if >24h))
• Suspected bacterial endocarditis
• Severe extra-cranial carotid artery stenosis/occlusion
• Suspected cerebral vasculitis or aortic dissection
• Occlusions in multiple vascular territories
CPMC Stroke Triage >12-24h or non Treatment Candidate

- MRI ± MRA/CTA;
  - CUS if MRA/CTA unavailable (ant circ)
  - Other w/u depends on stroke morphology etc

- TIA managed similar to stroke especially if major symptoms (hemiplegia etc)
  - MRI/CTA/CTP acutely may permit d/c from ED
CPMC Suggested Local Site Triage Overview

• Many possible exceptions
• Generally better to call Stroke Neurology and discuss individual case
• However, many sites want written protocol
  – Difficult given rapidly changing situation and advances
  – Need flexibility and constant reassessment
  – Depends strongly on available local resources/capabilities
CPMC Suggested Local Site Imaging Options: CTA/CTP Available

- All patients ≤ 6-12h receive CTA/CT
  - regardless of NIHSSS
- NIHSS≥10 receive CTA/CTP
- Stroke patients receive CTA/CTP after consultation
  - Depends on local CTA/CTP availability, stroke neuro availability, distance, severity, age, other local factors
CPMC Suggested Remote Site Options: NO CTA/CTP Available

• \( \leq 24h \) AND sx disabling (no NIHSS cut-off)
  – Consult stroke neurologist for possible transfer
• >24h or minor symptoms
  – local management vs. transfer for higher level of care
Other Local Site Issues

- **CTA/CTP**
  - Image acquisition speed/availability
  - CT technician/radiology experience
    - CTP in particular requires significant training
- **Unclear if CTP needed for remote patients**
  - CTA more useful for triage purposes?
  - Question of which patients to screen?
  - Generally higher NIHSS=more likely occlusion
CPMC Transferred Pt Protocol

• Transfer IA candidates receive CTA/CTP even if previously performed
  – To assess current brain/vascular state after transfer
Tertiary Center Issues

• Capacity: Most centers under-resourced
  – ~40% acute strokes ($\leq 24\text{h}$) have vessel occlusion
  – Physicians
    • High on-call burden; few qualified (credentialing)
  – Call teams, facilities limited
    • $\geq 2$ simultaneous stroke management?

• Triage: in hospital and throughout network

• Quality control: transfer/treatment speed

• Communication internal/external
Stroke Network Issues

• Treatment guidelines
  – IV rt-PA use criteria
  – IA tx time windows (6, 8, 12, 24h?)

• Transfer guidelines
  – Triage to closest capable site
  – Alternate sites if primary is unavailable

• Centralized/coordinated transfer center?
Conclusion

• A comprehensive reassessment of stroke management is needed
• Careful consideration of resources is necessary
• An ideal system is feasible but must be thought out and executed in a logical way