Acute Stroke Interventions: Indications, Access, & Outcomes

Daniel Cooke
Asst. Prof. Dept. of Radiology UCSF
Director NIR ZSFG
UCSF Vascular Symposium
Thursday, April 4
3:45-4:05pm

Disclosures

• None
The Message

• Time is brain.
  – The interval from symptom onset to reperfusion is the most significant modifiable variable in predicting clinical outcome.

Outline

• Background
• Evidence
  – Time
  – Physiology
• Workflow
  – Direct-to-Angio
  – Anesthesia
  – Access
AIS

- **Epidemiology**
  - 800K/year US
    - 5th leading cause mortality
    - Leading cause morbidity
  - **Natural History Large Vessel Occlusion**
    - ~15% of all ischemic stroke
    - Resistant to IV r-tPA with low rates of early recanalization
      - distal ICA 4.4%,
      - M1-MCA 32.3%,
      - M2-MCA 30.8%,
      - basilar 4%

# Trials Summary

<table>
<thead>
<tr>
<th>Trial</th>
<th>NHSS Range</th>
<th>r-PA</th>
<th>TICI</th>
<th>LSN to groin</th>
<th>mRS 0-2 at 90 d</th>
<th>sICH</th>
<th>Device Complications</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 CLEAN&lt;sup&gt;1&lt;/sup&gt;</td>
<td>18 (14-21)</td>
<td>90%</td>
<td>59%</td>
<td>260</td>
<td>19%</td>
<td>33%</td>
<td>Embol. 13</td>
<td>22% 21%</td>
</tr>
<tr>
<td>ESCAPE&lt;sup&gt;1&lt;/sup&gt;</td>
<td>17 (12-20)</td>
<td>70%</td>
<td>72%</td>
<td>200</td>
<td>29%</td>
<td>53%</td>
<td>Perfor.1</td>
<td>19% 10%</td>
</tr>
<tr>
<td>EXTEND IA&lt;sup&gt;1&lt;/sup&gt;</td>
<td>13 (9-19)</td>
<td>100%</td>
<td>80%</td>
<td>210</td>
<td>40%</td>
<td>71%</td>
<td>0% 0%</td>
<td>20% 9%</td>
</tr>
<tr>
<td>SWIFT PRIME&lt;sup&gt;1&lt;/sup&gt;</td>
<td>17 (13-19)</td>
<td>98%</td>
<td>88%</td>
<td>224</td>
<td>36%</td>
<td>60%</td>
<td>SAH 4</td>
<td>12% 9%</td>
</tr>
<tr>
<td>REVASCAT&lt;sup&gt;1&lt;/sup&gt;</td>
<td>17 (12-19)</td>
<td>73%</td>
<td>66%</td>
<td>269</td>
<td>29%</td>
<td>44%</td>
<td>Perfor. 5</td>
<td>16% 18%</td>
</tr>
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</table>

Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials


HERMES
The Highly Effective Reperfusion evaluated in Multiple Endovascular Stroke Trials (HERMES) collaboration
HERMES

• Pooled patient data from 5 RCTs
  – 1287 patients
  – Pre-specified outcomes
    • Sub group analysis


• 2.6 NNTT for 1 point mRS improvement at 90 days
### HERMES

<table>
<thead>
<tr>
<th>Intervention population</th>
<th>Control population</th>
<th>Risk difference (%)</th>
<th>Rate ratio (95% CI)</th>
<th>Odds ratio (95% CI)</th>
<th>Adjusted rate ratio (95% CI)</th>
<th>Adjusted odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRS score reduction (shift analysis; primary outcomes)*</td>
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</tr>
<tr>
<td>mRS score 0-1 at 90 days</td>
<td>26.9% (270/1,013)</td>
<td>12.2% (83/6,413)</td>
<td>14.0</td>
<td>2.00 (1.54-2.60); p=0.0001</td>
<td>2.49 (1.84-3.35); p=0.0001</td>
<td>2.06 (1.59-2.60); p=0.0001</td>
</tr>
<tr>
<td>mRS score 0-2 at 90 days</td>
<td>46.0% (291/6,311)</td>
<td>26.5% (1,712/6,415)</td>
<td>19.5</td>
<td>1.71 (1.41-2.05); p=0.0001</td>
<td>2.35 (1.85-2.98); p=0.0001</td>
<td>1.73 (1.43-2.09); p=0.0001</td>
</tr>
<tr>
<td>NIHSS score 0-2 24 h</td>
<td>21.0% (229/1,065)</td>
<td>3.8% (52/6,310)</td>
<td>12.7</td>
<td>2.47 (1.79-3.41); p=0.0001</td>
<td>2.91 (2.06-4.12); p=0.0001</td>
<td>2.66 (1.92-3.67); p=0.0001</td>
</tr>
<tr>
<td>Early neurological recovery at 24 h</td>
<td>50.2% (259/516)</td>
<td>21.2% (134/633)</td>
<td>29.0</td>
<td>2.34 (1.91-2.87); p=0.0001</td>
<td>2.40 (2.07-2.81); p=0.0001</td>
<td>2.34 (1.91-2.87); p=0.0001</td>
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<tr>
<th>Symptomatic intracranial haemorrhage</th>
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<tbody>
<tr>
<td>4.4% (28/634)</td>
<td>4.3% (28/653)</td>
<td>0.1</td>
<td>1.06 (0.63-1.80); p=0.82</td>
<td>1.07 (0.62-1.83); p=0.81</td>
<td>1.07 (0.62-1.80); p=0.81</td>
<td>1.07 (0.62-1.84); p=0.81</td>
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<tr>
<th>Parenchymal haematoma type 2</th>
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</thead>
<tbody>
<tr>
<td>5.1% (22/629)</td>
<td>5.3% (34/631)</td>
<td>-0.2</td>
<td>0.99 (0.63-1.56); p=0.97</td>
<td>0.99 (0.60-1.63); p=0.97</td>
<td>1.00 (0.61-1.69); p=0.98</td>
<td>1.04 (0.63-1.72); p=0.88</td>
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<tr>
<th>Mortality</th>
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<tr>
<td>5.3% (97/633)</td>
<td>18.9% (122/646)</td>
<td>-3.6</td>
<td>0.82 (0.63-1.07); p=0.15</td>
<td>0.82 (0.63-1.07); p=0.16</td>
<td>0.82 (0.62-1.08); p=0.15</td>
<td>0.82 (0.62-1.08); p=0.16</td>
</tr>
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### HERMES

| Age (years) | Sex | NIHSS score <24 h | | | | |
|-------------|-----|-------------------| | | | |
| <30 | 2187 | 1.05 (1.02-1.08) | | | | |
| 30-39 | 23 | 0.95 (0.46-2.00) | | | | |
| 40-49 | 47 | 0.88 (0.47-1.69) | | | | |
| 50-59 | 291 | 0.83 (0.50-1.41) | | | | |
| 60-69 | 233 | 1.04 (0.64-1.68) | | | | |
| 70-79 | 257 | 2.49 (1.55-3.97) | | | | |
| >80 | 189 | 3.65 (1.95-6.82) | | | | |

<table>
<thead>
<tr>
<th>Stroke location</th>
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<tbody>
<tr>
<td>0-2</td>
<td>174</td>
<td>0.95 (0.55-1.64)</td>
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<tr>
<td>Male</td>
<td>464</td>
<td>0.96 (0.86-1.07)</td>
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<tr>
<td>Female</td>
<td>56</td>
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<tbody>
<tr>
<td>Yes</td>
<td>572</td>
<td>0.95 (0.86-1.07)</td>
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<td>No</td>
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| Total | 1378 | 0.95 (0.86-1.07) | | | | |

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| Total | 1378 | 0.95 (0.86-1.07) | | | | |
• 6% decrease in absolute risk difference in good outcome (mRS < 3) for every hour delay in reperfusion.

AHA/ASA 2015 Guidelines

Patients should receive mechanical thrombectomy with a stent retriever if they meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or MCA segment 1 (M1); (3) age ≥18 years; (4) NIHSS score of ≥6; (5) ASPECTS of ≥6, and (6) treatment can be initiated (groin puncture) within 6 hours of symptom onset.
Physiology

- Beyond 6 hours
- Unknown LSN
Time vs. Physiology

- **DAWN (n = 206)**
  - Intervention vs. Medical 6 – 24 hours LSN
    - Stopped early (2.28.17)
  - 90 day mRS < 3: 48.6% vs. 13.1%
    - NNT 2.8

![Thrombectomy Intention-to-Treat Population](image1)


Time vs. Physiology

- **DEFUSE 3 (n = 182)**
  - Intervention vs. Medical 6 – 16 hours LSN
  - < 70 ml (core) AND > 1.8 penumbra:core
  - 90 day mRS < 3: 41% vs. 11.5%

![Thrombectomy Score on Modified Rankin Scale](image2)

**AHA/ASA 2018 Guidelines**

**AHA/ASA Guideline**

2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Reviewed for evidence-based integrity and endorsed by the American Association of Neurological Surgeons and Congress of Neurological Surgeons

Endorsed by the Society for Academic Emergency Medicine

William J. Powers, MD, FAHA, Chair; Alejandro A. Rabinstein, MD, FAHA, Vice Chair;
Teri Ackerson, BSN, RN; Opeolu M. Adebajo, MD, MS, FAHA;
Nicholas C. Bambakidis, MD, FAHA; Kyna Becker, MD, FAHA; José Biller, MD, FAHA;
Michael Brown, MD, MSc; Bart M. Denaerschulck, MD, MSc, FAHA; Brian Hob, MD, FAHA;
Edward C. Jauch, MD, MS, FAHA; Chelsea S. Kidwell, MD, FAHA;
Thabele M. Leslie-Mazwi, MD; Bruce Ovbiagele, MD, MSc, MAS, MBA, FAHA;
Phillip A. Scott, MD, MBA, FAHA; Kevin N. Sheth, MD, FAHA;
Andrew M. Southerland, MD, MSc; Deborah V. Summers, MSN, RN, FAHA;
David L. Tirschwell, MD, MSc, FAHA; on behalf of the American Heart Association Stroke Council

---

**AHA/ASA 2018 Guidelines**

In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.
Beyond RCTs

• Core infarct (CBF): “too sick”

Campbell et al. The Lancet Neurology, 2019
Beyond RCTs

• Clinical presentation (NIHSS < 6): “too well”
  – Sarraj et al.
    • 90 MM vs. 124 EVT
    • 67% vs. 63% mRS 0-2 @ 90 days
    • 0% vs. 6% SICH

WORKFLOW: MAKING TIME
Workflow

Bourcier et al. JAMA Neurology. 2019
Workflow

• Direct-to-angio
  – Psychogios et al.
    • 44 (MDCT) vs. 30 patients (FPCT)
    • 22/30 with AIS
    • 54.5 min vs. 20.5 min


• Direct-to-angio
  – Mendez et al.
    • 145 (MDCT) vs. 97 (FPCT)
    • 79/97 with LVO AIS
    • 70 min vs. 16 min

Mendez et al. Stroke. 2018
Workflow

- **Direct-to-angio**

Workflow

- **Anesthesia**
  - Campbell et al. (Lancet Neuro., 2018)
    - Meta analysis 797 patients (236 GA)
    - 50% vs. 40% mRS < 3 at 90 days (p = 0.008)
Workflow

• Access
  – Femoral
  – Radial
  – Carotid

Chen et al. (n = 18)

• Radial access
• No difference in puncture-to-reperfusion times (~ 60 min) relative to femoral access.
• Similar TICI, pass number, and mRS

Chen et al. JNIS. 2019
Workflow

- Access
  - Fjetland et al. (n = 7)
    - Carotid access
    - Access to reperfusion time 45 min. (mean)
    - 1 hematoma requiring surgery (manual compression for all others).
    - 100% TICI2b or 3
Conclusion

• Standard of care
• Time is brain
  – Minutes matter
  – Code Culture

UCSF/ZSFG are the Stroke Centers for the Bay Area

Thank you

Questions?
Daniel.cooke@ucsf.edu
Mission Protocol

- Who’s eligible: +Cincinnati Prehospital Stroke Scale and Last Known Normal < 6 hours → ambulance notifies ZSFG
- ZSFG RN asks for primary language, anticoagulant use, placement of 18g IV
- EMS obtains vitals, IV, fingerstick glucose
- Patient arrives at Mission Drop-off (hallway at ambulance entrance across from CT 1)
- Welcoming committee: ED RN, MEA, ED resident and attending

Mission Protocol

- Neurology resident joins team
- ED RN draws labs off existing IV, does assessment, places transport monitor, removes metal jewelry
- ED resident does rapid assessment: ABCs, FAST-ED plus threat score, focused exam to determine: stable CVA, unstable CVA, not CVA
- If stable CVA: to CT on EMS gurney, weigh in on way in
Mission Protocol

- IV-tPA given while on CT table
- If 2nd line not established, placed on CT table
- CT angiogram and perfusion
- If large vessel occlusion: direct to NIR Suite

Mission Protocol

- Launched July 2017
- Stroke metrics through 9/30/18:
  - Door-to-CT: 13 minutes (mean), 8 minutes (median)
  - Door-to-tPA (n=90): 40 minutes (mean), 34 minutes (median)
  - Door-to-embolectomy (groin puncture) (n=43): 99 minutes (mean), 94 minutes (median)
Goal of Ischemic Stroke Treatment

Before Intervention

After Successful Intervention

Images courtesy of Dr. Joey English – Used with Permission. Results from case studies are not predictive of results in other cases. Results in other cases may vary.
Workflow

• Anesthesia
  – Henden et al. (Stroke., 2017)
    • AnStroke RCT 90 patients
    • 42% vs. 40% mRS < 3 at 90 days (p = 1)


• Anesthesia
  – Simonsen et al. (JAMA Neuro., 2018)
    • GOLIATH RCT 128 patients
    • OR 1.9 mRS < 3 at 90 days

Simonsen CZ, Yoo AJ, Sørensen LH, Juul N, Jønsson SP, Andersen G, Rasmussen M. Effect of General Anesthesia and Conscious Sedation During Endovascular Therapy on Infarct Growth and Clinical Outcomes in Acute Ischemic Stroke: A Randomized Clinical Trial. JAMA Neurol. 2018 Jan 16
It is reasonable to select an anesthetic technique during endovascular therapy for AIS on the basis of individualized assessment of patient risk factors, technical performance of the procedure, and other clinical characteristics. Further randomized trial data are needed.” COR, LOE (IIa, B-R)