Prehospital Stroke Triage and Use of Prehospital Stroke Scales

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Presenter Disclosure Information

Christian Martin-Gill, MD, MPH
Prehospital Quality Metrics for Stroke

FINANCIAL DISCLOSURE:
No relevant financial relationship exists
New Studies in Advanced Stroke Care

- 5 randomized controlled trials published since January 2015
  - All provide strong evidence of benefit of intra-arterial therapy for select stroke patients with large vessel occlusions
  - Therapy largely guided by imaging
  - All patients were eligible for thrombolytics if within window prior to intra-arterial therapy

- Studies:
  - MR CLEAN
  - ESCAPE
  - EXTEND-IA
  - REVASCAT
  - SWIFT PRIME

Which Patients have Large Vessel Occlusions?
Treatment Goals for Stroke Patients

The Road Ahead: Improving Stroke Triage in the Field
Stroke Ready Hospital

- Can perform a rapid assessment including non-contrast CT scan (to rule out intracranial bleeding)
- Can consult with Neurologists (in person or telemedicine)
- Can administer IV thrombolytics, when needed
- Has protocols for standardized care
- Will usually transfer patients that receive IV thrombolytics

Primary Stroke Center

- Can perform a rapid assessment including CT scan +/- advanced imaging
- Can consult with Neurologists (in person or telemedicine)
- Can administer IV thrombolytics, when needed
- Has protocols for standardized care
- May admit patients that receive IV thrombolytics for continued stroke care
Comprehensive Stroke Center

In addition to requirements for Primary Stroke Center:

- Dedicated vascular neurologists and neurosurgeons
- Dedicated Neuro ICU beds 24/7
- Advanced imaging capabilities (CTA, MRA)
- Can perform endovascular procedures
- Experience in treating ischemic strokes and hemorrhages
Goals and Metrics for Prehospital Stroke Care

Goals:
- Perform an appropriate prehospital assessment
  - Identify non-stroke illness (e.g., hypoglycemia)
  - Identify stroke
  - Identify stroke severity
- For patients with suspected stroke
  - Time to diagnostic studies
- For patients who are eligible for stroke treatment
  - Time to intervention
National Institutes of Medicine Stroke Scale

Comparing National Institutes of Health Stroke Scale Among a Stroke Team and Helicopter Emergency Medical Service Providers
Matthew R. Kesinger, BA; Denise J. Sequeira, BA; Samantha Buffalini, RN(c); Francis X. Guinto, MD, MPH

Background and Purpose—The use of tissue-type plasminogen activator is limited to a maximum of 4.5 hours after symptom-onset. Endovascular revascularization may improve outcomes for large-vessel occlusions (LVO), but efficacy decreases with time from symptom-onset. A National Institutes of Health Stroke Scale (NIHSS) score ≥12 is predictive of LVOs and can be used to triage patients if appropriately used by prehospital providers. The NIHSS has been considered too complex and has not been validated in the prehospital setting.

Methods—We reviewed all patients with ischemic stroke transported by helicopter emergency medical services (HEMS) to a single comprehensive stroke center in 2010. HEMS NIHSS were compared with in-hospital stroke team physicians scores. NIHSS was categorized based on: 1) clinically relevant groupings and ability to predict LVO was investigated.

Results—Three hundred five patients met inclusion criteria, 69.9% having LVO. Moderate agreement existed between HEMS and physicians (0.71; 95% confidence interval, 0.64–0.78). Inclusion correlation was 0.679 (95% confidence interval, 0.608–0.750). Excluding patients with tissue-type plasminogen activator before HEMS transport, there were 216 patients and good agreement (0.72; k = 0.619). Among patients presenting within 6 hours postonset and NIHSS ≥12, HEMS had a sensitivity of 55.9% and positive predictive value of 83.7% as predicting LVO.

Conclusions—HEMS providers can administer NIHSS with moderate to good agreement with the receiving stroke team.

The use of the NIHSS in HEMS may identify patients with LVO and inform triage decisions for patients ineligible for tissue-type plasminogen activator. (Stroke. 2013;46:275–278. DOI: 10.1161/STROKEAHA.114.007850.)
How should EMS providers identify stroke and especially those with large vessel occlusion?

- **Stroke Scales**
  - Cincinnati Prehospital Stroke Scale (CPSS)
  - Face Arm Speech Test (FAST)
  - Los Angeles Prehospital Stroke Screen (LAPSS)
  - Medic Prehospital Assessment for Code Stroke (Med PACS)
  - Melbourne Ambulance Stroke Screen (MASS)
  - Ontario Prehospital Stroke Screening Tool (OPSS)
  - Recognition of Stroke in the Emergency Room Score (ROSIER)

- **Severity Scales**
  - Rapid Arterial Occlusion Evaluation Scale (RACE)
  - Los Angeles Motor Scale (LAMS)
  - Kurashiki Prehospital Stroke Scale (KPSS)
  - National Institutes of Health Stroke Scale (NIHSS)
  - sNIHSS-8
  - sNIHSS-5
  - Cincinnati Prehospital Stroke Severity Scale (CPSSS)

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Cincinnati Prehospital Stroke Scale (CPSS)

- First published in 1997
- Primary stroke identification scale used in PA
- Exam:
  - Facial palsy
  - Arm drift
  - Abnormal speech
- Sensitivity 59-95% (prior literature)
- Does not distinguish large-vessel occlusion
Los Angeles Prehospital Stroke Screen (LAPSS)

- First published in 1998
- History factors:
  - Age >45 years
  - No seizures or epilepsy
  - Symptoms <12 hours
  - Not wheelchair/bedridden
  - Glucose 60-400
- Exam Factors:
  - Facial smile/grimace
  - Grip
  - Arm strength
  - [each only unilateral]

  • Sensitivity 44-94%
    (prior literature)

  • Does not distinguish large-vessel occlusion

Cincinnati Prehospital Stroke Severity Scale

- Based on CPSS
- ≥2 suggests LVO
- Sensitivity 75%
- Specificity 85%

<table>
<thead>
<tr>
<th>Exam</th>
<th>NIHSS</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjugate gaze deviation</td>
<td>≥1 for Gaze</td>
<td>0 or 2</td>
</tr>
<tr>
<td>LOC</td>
<td>≥1 for 1b or 1c</td>
<td>0-1</td>
</tr>
<tr>
<td>Arm Strength</td>
<td>≥2 for Motor Arm</td>
<td>0-1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0-4</td>
</tr>
</tbody>
</table>
• Based on LAPSS
• Score ≥4 suggests LVO
• Sensitivity 67-81%
• Specificity 81-89%

**Los Angeles Motor Score**

**THE LOS ANGELES MOTOR SCALE (LAMS):**
A NEW MEASURE TO CHARACTERIZE STROKE SEVERITY IN THE FIELD
Jennifer N. Llanes, BA, Chelsea S. Kidwell, MD, Sidney Starkman, MD,
Megan C. Leary, MD, Marc Eckstein, MD, Jeffrey L. Saver, MD

<table>
<thead>
<tr>
<th>Exam</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial Strength</td>
<td>0-1</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>0-2</td>
</tr>
<tr>
<td>Arm Strength</td>
<td>0-2</td>
</tr>
<tr>
<td>Total</td>
<td>0-5 (unilateral)</td>
</tr>
</tbody>
</table>

• Introduced 2014 with internal validation in Barcelona, Spain
• Thought to be simpler to assess by field providers than scores used in the hospital (e.g. NIH Stroke Scale)
• Currently being assessed in various EMS systems for prehospital stroke severity screening
RACE Score

- 6 data points
  - 2 already part of CPSS

- Adds:
  - Leg weakness
  - Head/eye gaze deviation
  - Performing 2 commands (Aphasia)
  - Recognizing arm and clapping (Agnosia)

RACE Score

- Large-vessel occlusion suspected if score ≥5
  - Sensitivity: 85%
  - Specificity: 65%

- Published score based on internal validation

- Undergoing further investigation in our EMS region
Validation of Prehospital Stroke Scales in Patients Transported by Air Medical Services

- Retrospective study of patients transported by STAT MedEvac between 2010-2015 for suspected stroke
  - Excluded patients with known intracranial hemorrhage
  - Stroke severity scores derived from NIHSS performed by air medical crews
- Data from prehospital records and Get with the Guidelines database
- Results
  - 1,244 cases included
    - 941 interfacility
    - 303 scene transports

Calculation of Stroke Severity Scores

<table>
<thead>
<tr>
<th>NIHSS</th>
<th>CPSSS</th>
<th>KPSS</th>
<th>LAM</th>
<th>sNIHSS-8</th>
<th>sNIHSS-5</th>
<th>RACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alertness</td>
<td>0</td>
<td>1-2</td>
<td>3</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Orientation</td>
<td>0</td>
<td>1-2</td>
<td>1</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Commands</td>
<td>0</td>
<td>1-2</td>
<td>1</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Best Gaze</td>
<td>0</td>
<td>1-2</td>
<td>2</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Visual</td>
<td>0-3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-3</td>
<td>0-3</td>
</tr>
<tr>
<td>Facial Paralysis</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0-25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Motor Arm</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3-4</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Motor Leg</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3-4</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Language (Aphasia)</td>
<td>0</td>
<td>1-2</td>
<td>3</td>
<td>1-2</td>
<td>1-2</td>
<td>-</td>
</tr>
<tr>
<td>Dysarthria</td>
<td>0</td>
<td>1-2</td>
<td>3</td>
<td>1-2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Executive Impairment</td>
<td>0</td>
<td>0-2</td>
<td>-</td>
<td>-</td>
<td>0-2</td>
<td>-</td>
</tr>
</tbody>
</table>

Score Range: 0 to 42
### Performance of Stroke Severity Scales for Identifying Large Vessel Occlusion

<table>
<thead>
<tr>
<th>NIHSS</th>
<th>Classified</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 7</td>
<td>71%</td>
<td>71% (67-75)</td>
<td>72% (64-74)</td>
<td>0.43</td>
</tr>
<tr>
<td>≥ 9</td>
<td>69%</td>
<td>65% (61-68)</td>
<td>81% (76-85)</td>
<td>0.46</td>
</tr>
<tr>
<td>≥ 10</td>
<td>68%</td>
<td>62% (58-66)</td>
<td>82% (77-86)</td>
<td>0.44</td>
</tr>
<tr>
<td>≥ 11</td>
<td>65%</td>
<td>57% (53-61)</td>
<td>84% (80-88)</td>
<td>0.41</td>
</tr>
<tr>
<td>CPSSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 0</td>
<td>74%</td>
<td>100% (99-100)</td>
<td>0% (0-0.02)</td>
<td>0.0</td>
</tr>
<tr>
<td>≥ 1</td>
<td>71%</td>
<td>72% (68-76)</td>
<td>69% (62-73)</td>
<td>0.41</td>
</tr>
<tr>
<td>≥ 2</td>
<td>61%</td>
<td>52% (48-56)</td>
<td>84% (80-88)</td>
<td>0.36</td>
</tr>
<tr>
<td>≥ 3</td>
<td>56%</td>
<td>42% (38-46)</td>
<td>92% (88-94)</td>
<td>0.34</td>
</tr>
<tr>
<td>KPSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 3</td>
<td>71%</td>
<td>75% (72-79)</td>
<td>58% (52-63)</td>
<td>0.33</td>
</tr>
<tr>
<td>≥ 4</td>
<td>68%</td>
<td>68% (64-72)</td>
<td>67% (61-72)</td>
<td>0.35</td>
</tr>
<tr>
<td>≥ 5</td>
<td>65%</td>
<td>60% (55-63)</td>
<td>78% (73-83)</td>
<td>0.38</td>
</tr>
<tr>
<td>≥ 6</td>
<td>53%</td>
<td>43% (39-47)</td>
<td>84% (80-88)</td>
<td>0.27</td>
</tr>
<tr>
<td>≥ 7</td>
<td>47%</td>
<td>32% (29-37)</td>
<td>90% (86-93)</td>
<td>0.22</td>
</tr>
<tr>
<td>LAMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1</td>
<td>74%</td>
<td>87% (84-90)</td>
<td>38% (33-44)</td>
<td>0.25</td>
</tr>
<tr>
<td>≥ 2</td>
<td>70%</td>
<td>77% (73-80)</td>
<td>52% (46-58)</td>
<td>0.29</td>
</tr>
<tr>
<td>≥ 3</td>
<td>66%</td>
<td>65% (61-69)</td>
<td>68% (62-73)</td>
<td>0.33</td>
</tr>
<tr>
<td>≥ 4</td>
<td>47%</td>
<td>33% (29-37)</td>
<td>89% (85-92)</td>
<td>0.22</td>
</tr>
</tbody>
</table>

### Modified RACE Score

**Rapid Arterial Occlusion Evaluation**

<table>
<thead>
<tr>
<th>EMS Service:</th>
<th>Patient Name:</th>
<th>DOB:</th>
<th>Date of Exam:</th>
<th>Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS Unit:</td>
<td>Symptom Onset Date:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Date of Exam:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech*</td>
<td>Normal Speech</td>
<td>No numerical value</td>
<td>Abnormal Speech</td>
<td></td>
</tr>
<tr>
<td>Facial Palsy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Motor Function*</td>
<td>Normal (no drift to mid drift)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg Motor Function*</td>
<td>Normal (no drift to mid drift)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart &amp; Gaze Deviation</td>
<td>Absent (fixed or unstable gaze)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aphasia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ageonias</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If total score ≥3 and time from last known well to arrival at the closest Primary Stroke Center will be >3 hours, contact Medical Command for consideration of transport to a facility capable of performing endovascular interventions.

**U.S. Preventive Services Task Force**

- The preventive services task force of the U.S. Preventive Services Task Force has recommended that community health centers offer screening for hypertension.
- The preventive services task force of the U.S. Preventive Services Task Force has recommended that community health centers offer screening for obesity.
- The preventive services task force of the U.S. Preventive Services Task Force has recommended that community health centers offer screening for diabetes.

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*Any abnormal finding in speech, facial palsy, or arm motor function is a positive finding for the Cincinnati Prehospital Stroke Screen.

*A RACE score ≥3 is a strong indication of a large vessel occlusion (LVO). Treatment with IV thrombolysis is not as effective as TPA and endovascular treatment.
Updated Stroke Triage Protocol in Pennsylvania

Is acute stroke suspected by Cincinnati Prehospital Stroke Scale (CPSS)?

- Race: facial droop present,
- Arm: upper extremity arm drift present (arms extended palms up),
- Speech: inability to say, “The sky is blue in Pennsylvania” normally.

AND

Time: time since last known well ≤ 12 hours

Exclude patient if previous history of stroke within last 10 months, OR Major surgery within last 14 days.

YES

6-12 hours since last known well

- Package Patient Appropriately
- Check Glucose
- Transport to closest certified Primary Stroke Center (Designated, Comprehensive Stroke Center, Designated, or Acute Stroke Ready Hospital, if permitted)
- Transport in supine position

NO

>12 hours since last known well

- Infuse IV NS5
- Check Glucose
- Consider Drawing Blood

Contact Medical Command

UPMC Stroke Alerts

<table>
<thead>
<tr>
<th>Time since last known well</th>
<th>Level 1 Alert</th>
<th>Level 2 Alert</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6 Hours</td>
<td>Direct to CT if available</td>
<td>Prompt evaluation in room</td>
</tr>
<tr>
<td>6 – 24 Hours</td>
<td>Level 1</td>
<td>Level 2</td>
</tr>
<tr>
<td>&gt;24 Hours</td>
<td>No Alert</td>
<td>No Alert</td>
</tr>
</tbody>
</table>

RACE score ≥ 5 or NIHSS ≥ 8

RACE score < 5 and NIHSS < 8

Or Unknown Values
Stroke Metrics: Assessment

- For patients with stroke-like symptoms
  - % of cases with glucose
  - % of cases with stroke scale

- Performance of stroke scale
  - Sensitivity / Sensitivity
  - Positive Predictive Value

Stroke Metrics: Resources and Transport

- For patients with stroke-like symptoms
  - % of cases with appropriate stroke alert
  - % of tPA-eligible stroke patients transported to an appropriate stroke center
  - % of tPA-eligible stroke patients transported to an interventional or comprehensive stroke center
# Stroke Metrics: Times

<table>
<thead>
<tr>
<th>Time Point</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Known Well</td>
<td></td>
</tr>
<tr>
<td>Dispatch Time</td>
<td></td>
</tr>
<tr>
<td>First Medical Contact (EMS)</td>
<td>Response Time</td>
</tr>
<tr>
<td>Hospital Notification</td>
<td>Notification Time</td>
</tr>
<tr>
<td>Arrival to ED</td>
<td>Time to ED</td>
</tr>
<tr>
<td>CT of the Head</td>
<td>Time to CT</td>
</tr>
<tr>
<td>IV tPA</td>
<td>Time to Needle</td>
</tr>
<tr>
<td>Arrival to Intervention Lab</td>
<td>Time to Lab</td>
</tr>
<tr>
<td>Initiation of Endovascular Treatment</td>
<td>Time to Intervention</td>
</tr>
</tbody>
</table>