Different Strokes For Different Folks

Invasive Interventions and Triage Challenges for CVAs

Peter Antevy, MD, EMS Medical Director, Broward/Palm Beach FL
ELVO Has Entered the Building

Facilitating Cerebral Embolectomy for Large Vessel Occlusion

Peter Antevy, MD, EMS Medical Director, Broward/Palm Beach FL
Disclosures

• One important one
Questions

• What role does EMS play in OUTCOMES for stroke?

• Can we predict which patients need intervention from the Field?

• Can we leverage technology to improve outcomes?
Historical Perspective
<table>
<thead>
<tr>
<th>Modified Rankin Scale</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No symptoms – No Disability</td>
<td>Minor symptoms – Back to Work</td>
<td>Independent – ADLs effected</td>
<td>Requires Assistance</td>
<td>Continued Nursing Care</td>
<td>24 Hour Skilled Nursing</td>
<td>Deceased</td>
</tr>
</tbody>
</table>

**GOOD**

**FAV**
First Stroke Revolution?

- 1995
- IV tPA trials
- Stroke as an acute neurologic illness
  - “Tissue plasminogen activator for acute ischemic stroke” NEJM 1995

Stroke Evolves!
IV tPA Works For ALL!

Saver et al., Stroke 2007
Vessel Anatomy

- Distal
- M2
- M1
- ICA
Maybe Not!

In the study by Ingall et al. (Stroke 2004;35;2418-2424), the percentage of favorable outcomes is shown to vary with different pre-treatment NIHSS scores and the presence of various occlusions (No proximal occlusion, M2 occlusion, M1 occlusion, ICA occlusion) for those treated with tPA compared to placebo.
IV tPA Success Rates

Saqqur et al, Neurology 2008
Next Stroke Revolution

- 1999
- IA tPA trials
- Documented MCA occlusion

Outcomes?
## IA Therapy: A New Hope

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Recanalization</th>
<th>Symptomatic Hemorrhage</th>
<th>MRS ≤ 2</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro-UK (n=121)</td>
<td>66%</td>
<td>10%</td>
<td>40%</td>
<td>25%</td>
</tr>
<tr>
<td>Placebo (n=59)</td>
<td>18%</td>
<td>2%</td>
<td>25%</td>
<td>27%</td>
</tr>
<tr>
<td>NINDS -1 (n=291)</td>
<td>6%</td>
<td>47%</td>
<td></td>
<td>21%</td>
</tr>
</tbody>
</table>

Twice as likely to have a positive outcome
IA vs. IV : Late 1990’s

EMS Arrival

0-3 hr

IV tPA

Improved

3-6 hr

IA tPA

Failed
Then in 2004

“The Lord Had Merci”

Outcomes not so good
mRs 0 – 2 in only 36%
IA vs. IV: “Bridging”

EMS Arrival

0 - 4.5 hr
2009

IV tPA

Improved

Failed

Thrombectomy

3-6 hr
Then in 2012....

Outcomes Dwarf Merci
2013 – The $&IT Hit the Fan

Long-awaited stroke studies show hopeful new treatment no better than older one

Clot-retrieval no better for strokes

Recovery after stroke is not improved by using a device to retrieve the clot, a US study suggests.

In a trial of more than 650 patients, standard clot-busting drugs were just as effective as using surgery to clear blockages directly.

The University of Cincinnati-led study was stopped early after it became clear that risky procedures to remove clots were having little impact.

More than 650 patients were studied.

Experts said more work was needed over clot-retrieval devices.

Presenting the findings at the International Stroke Conference, researchers said that 39% of patients treated with a clot-busting drug were living independently after 90 days.
Major Issues Noted

1. Synthesis
2. IMS III
3. MR Rescue

Randomization by Symptoms

Cath Lab

Endovascular + IV

IV Alone

Time to reperfusion (minutes)
What’s the Real Story?

All 3 Showed Device Failure

1. ELVO not required for entry
2. 1<sup>st</sup>/2<sup>nd</sup> Generation devices used
3. Time to treatment not strict

Patients randomized by symptom not by disease
2015 Revolution

- Netherlands
- Randomized
- 16 Sites
- 0 – 6 hrs
- Non contrast CT

MR. CLEAN

Must Have
ELVO
MR CLEAN Difference

Randomization by Symptoms
1. Synthesis
2. IMS III
3. MR Rescue

Cath Lab

+ELVO → Cath Lab
Randomization by Disease

33% vs 16%

mRS 0 - 2
The Show Down

EMS MD

Hospital CEOs
The Flood Gates

Multiple Trials
MR CLEAN
SWIFT-PRIME
EXTEND IA
ESCAPE
REVASCAT
THERAPY
Positive Endovascular Stroke Trials 2015

Endovascular
Control

MR CLEAN
P<0.05
33%
19%

REVASCAT
P<0.05
44%
28%

ESCAPE
P<0.001
53%
29%

SWIFT PRIME
P<0.001
60%
36%

EXTEND-IA
P<0.01
71%
40%

THERAPY
NS
38%
30%

Good Outcome (%)
Rankin 0-2 at 90 days
The New Paradigm

CT Scan

IV tPA
If eligible

+ ELVO
0 – 6 hr
The Next Question

Is CT for Stroke = EKG for STEMI?
RACE Scale

Design and Validation of a Prehospital Stroke Scale to Predict Large Arterial Occlusion
The Rapid Arterial Occlusion Evaluation Scale

Natalia Pérez de la Ossa, MD, PhD; David Carrera, MD; Montse Gorchs, BD; Marisol Querol, BD; Mònica Millán, MD, PhD; Meritxell Gomis, MD, PhD; Laura Dorado, MD, PhD; Elena López-Cancio, MD, PhD; María Hernández-Pérez, MD; Vicente Chicharro, MD; Xavier Escalada, MD; Xavier Jiménez, MD, PhD; Antoni Dávalos, MD, PhD

**Background and Purpose**—We aimed to develop and validate a simple prehospital stroke scale to predict the presence of large vessel occlusion (LVO) in patients with acute stroke.

**Methods**—The Rapid Arterial Occlusion Evaluation (RACE) scale was designed based on the National Institutes of Health Stroke Scale (NIHSS) items with a higher predictive value of LVO on a retrospective cohort of 654 patients with acute ischemic stroke: facial palsy (scored 0–2), arm motor function (0–2), leg motor function (0–2), gaze (0–1), and aphasia or agnosia (0–2). Thereafter, the RACE scale was validated prospectively in the field by trained medical emergency technicians in 357 consecutive patients transferred by Emergency Medical Services to our Comprehensive Stroke Center. Neurologists evaluated stroke severity at admission and LVO was diagnosed by transcranial duplex, computed tomography, or MR angiography. Receiver operating curve, sensitivity, specificity, and global accuracy of the RACE scale were analyzed to evaluate its predictive value for LVO.

**Results**—In the prospective cohort, the RACE scale showed a strong correlation with NIHSS ($r=0.76; P<0.001$). LVO was detected in 76 of 357 patients (21%). Receiver operating curves showed a similar capacity to predict LVO of the RACE scale compared with the NIHSS (area under the curve 0.82 and 0.85, respectively). A RACE scale ≥5 had sensitivity 0.85, specificity 0.68, positive predictive value 0.42, and negative predictive value 0.94 for detecting LVO.

**Conclusions**—The RACE scale is a simple tool that can accurately assess stroke severity and identify patients with acute stroke with large artery occlusion at prehospital setting by medical emergency technicians. (*Stroke*. 2014;45:87-91.)
RACE Scale (0-9)

Cortical signs

Table 1. RACE Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>RACE Score</th>
<th>NIHSS Score Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial palsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mild</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Moderate to severe</td>
<td>2</td>
<td>2-3</td>
</tr>
<tr>
<td>Arm motor function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal to mild</td>
<td>0</td>
<td>0-1</td>
</tr>
<tr>
<td>Moderate</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>2</td>
<td>3-4</td>
</tr>
<tr>
<td>Leg motor function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal to mild</td>
<td>0</td>
<td>0-1</td>
</tr>
<tr>
<td>Moderate</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>2</td>
<td>3-4</td>
</tr>
<tr>
<td>Head and gaze deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>1</td>
<td>1-2</td>
</tr>
<tr>
<td>Aphasia* (if right hemiparesis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performs both tasks correctly</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Performs 1 task correctly</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Performs neither tasks</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Agnosia† (if left hemiparesis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient recognizes his/her arm</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>and the impairment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not recognized his/her arm</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>or the impairment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not recognize his/her arm</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>nor the impairment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score total</td>
<td>0-9</td>
<td></td>
</tr>
</tbody>
</table>

NIHSS, National Institutes of Health Stroke Scale; and RACE, Rapid Arterial Cord Evaluation.
RACE - Validation

![Graph showing the number of patients across different RACE scale scores for ischemic with LVO, ischemic without LVO, hemorrhagic, and mimic categories. ELVO is highlighted with a vertical line at score 5.]
Hospital Paradigm Shift

- Faster times
- Careful selection
- Better studies
- Innovative devices

Renewed Focus on Workflow
Parallel Workflow

A. Linear process

- Arrival at scene
- Basic Tx CPSS
- Telemetry Alert ED
- Arrival to ED
- ED Doctor evaluation
- Imaging evaluation
- Hold patient in ED
- NIR fellow alert
- IAT decision
- NIR team activation
- Setup suite
- Anesthesia activation
- Transfer to IR Suite
- Groin Puncture

B. Parallel process

- Arrival at scene
- Basic Tx RACE
- Facetime Neuro Doc
- Clinical evaluation
- NIR fellow alert
- IAT decision
- NIR team activation
- Setup suite
- Anesthesia activation
- Transfer to suite
- Groin puncture

Time saved
Field Activation by EMS

EMS STROKE ALERT

Obtain the following from EMS:

- RACE scale (0-9 score)
- Last known well time
- Anticoagulation (warfarin, pradaxa, xarelto, etc.)
- Estimated time of arrival

Actions to consider pre-hospital:

1. Alert neurologist on call for all stroke alerts
2. If RACE score >5 alert neurointerventionalist
3. Early cath lab activation = gaze preference + weakness
Stroke Process Metrics

MHS Median Time in Minutes (8/2014 - 7/2015)

<table>
<thead>
<tr>
<th>Step</th>
<th>Median Time (in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door-Picture</td>
<td>11</td>
</tr>
<tr>
<td>Picture-Puncture</td>
<td>60</td>
</tr>
<tr>
<td>Puncture-Treatment</td>
<td>23</td>
</tr>
</tbody>
</table>

115 Stroke Thrombectomy Cases
Goal P2P Time 60 minutes
# Impact of Process Improvement

![Bar chart showing the impact of process improvement on times for each phase of AIS evaluation in Door-Suite process.](chart.png)

## Times for Each Phase of AIS Evaluation in Door-Suite Process

<table>
<thead>
<tr>
<th>Phase</th>
<th>Median Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old Process (n=48)</td>
<td></td>
</tr>
<tr>
<td>Door to CT Scan</td>
<td>21</td>
</tr>
<tr>
<td>CT to MRI Scan</td>
<td>27</td>
</tr>
<tr>
<td>Imaging to Suite</td>
<td>55</td>
</tr>
<tr>
<td>Door to Suite</td>
<td>124</td>
</tr>
<tr>
<td>New Process (n=46)</td>
<td></td>
</tr>
<tr>
<td>Door to CT Scan</td>
<td>21</td>
</tr>
<tr>
<td>CT to MRI Scan</td>
<td>26</td>
</tr>
<tr>
<td>Imaging to Suite</td>
<td>29</td>
</tr>
<tr>
<td>Door to Suite</td>
<td>73</td>
</tr>
</tbody>
</table>
Impact of Process Improvement

Memorial Acute Stroke Door-to-Cath Lab Times

- **Before Process Changes**
  - January 2013-July 2014
  - (19 Months)
  - 32 cases
  - Average: 184m
  - Median: 166m

- **After Process Changes**
  - August 2014-July 2015
  - (12 Months)
  - 115 cases
  - Average: 51m
  - Median: 49m
Door to Cath Lab Improvement

Median Door-to-Cath Lab Arrival Time (minutes) Aug 2014-15
Acute Stroke Thrombectomy Cases

- No EMS Alert (N = 31): 71 minutes
- EMS Alert + Cath Lab Activated Post Imaging (N = 48): 53 minutes
- EMS Alert + Cath Lab Activated Pre-Imaging (N = 18): 32 minutes
Recently Launched

Entire Team Activation

pulsara

Stop STEMI
0 Alerts 1 Patient

Stop Stroke
0 Alerts 1 Patient

All Patients
More Coming Soon!

John Bozeman

VIEW/EDIT PT  VIEW ALERTS

ASSIGNED PHYSICIANS

EDMD: John DiPasquale

NEURO: Joe Bowers

RAD: NOT ASSIGNED

EMERGENCY DEPARTMENT

DOOR TIME 11:30 AM

NIHSS SET NA

NIHSS TIMER 03:21

RADIOLOGY
Acute Thrombectomy - 2015

74yoF left arm/leg weakness, NIHSS 16
Hallandale EMS (Station 90) → Memorial Regional
Full reperfusion with Solitaire device
Final NIHSS 1

Performance Metrics
Door-CT (Picture) 6 minutes
Picture-Puncture 39 minutes
Puncture-Treatment 12 minutes

ER Physician: Dr Donny Perez, Rads: Dr Vivek Patel
NeuroInterventionalist: Dr Brijesh Mehta, 617-775-5204
Acute Thrombectomy - 2015

Symptom Onset: 11:40am
CT Scan: 11:48am
Cath Lab: 12:17pm
Puncture: 12:40pm
Treatment: 12:55pm

Visible Clot
MCA Clot
Reperfusion
Aneurysm
Stent
Final MRI

PPines FR (Station 69) → Memorial West
26 year-old woman collapsed upon waking up
Full intracranial reperfusion with Solitaire device
Carotid pseudoaneurysm source of clot
Vessel reconstructed with covered stent
Very small stroke on MRI, discharge NIHSS 0

Performance Metrics
Onset-CT (Picture): 8 minutes
Picture-Puncture: 52 minutes
Puncture-Treatment: 15 minutes
Onset-Treatment: 75 minutes

ICU Physician: Dr Ari Sareli, Rads: Dr Peter Sullivan
NeuroInterventionalist: Dr Brijesh P Mehta, 617-775-5204
App helps first responders support stroke patients

 Posted: 11:09 AM, January 20, 2016
 Updated: 11:21 AM, January 20, 2016

39 Minutes
It Takes a Village

Dr. Charles Sand
EMS Medical Director
Tampa, FL

Dr. Paul Banerjee
EMS Medical Director
Polk County, FL

Dr. Randy Katz
EMS Medical Director
Hollywood, FL
Conclusion
ELVO Has Entered the Building

Facilitating Cerebral Embolectomy for Large Vessel Occlusion

Peter Antevy, MD, EMS Medical Director, Broward/Palm Beach FL