OBJECTIVES

**Discuss**
Discuss the difference in pre-hospital stroke screening and stroke severity scales.

**Discuss**
Discuss three clinical scales that can be used to predict large vessel occlusion (LVO).

**Identify**
Identify common neurological deficits of anterior severity scales that can be used when assessing for LVO stroke.

**Evaluate**
Review posterior circulation deficits and how to increase prediction of posterior stroke.
FASTER STROKE TREATMENT IS BETTER TREATMENT

Patients treated within 60 minutes experience improved outcomes, including lower in-hospital mortality and reduced long-term disability.

GC Fonarow et al. JAMA. 2014;311(16):1632-1640
Saver et al. JAMA. 2013;309(23):2480-8
SENSITIVITY

• Sensitivity also called the true positive predictive rate (PPR) measures the proportion of actual positives that are correctly identified. Refers to a test's ability to designate an individual with disease as positive. A highly sensitive test means that there are few false negative results, and thus fewer cases of disease are missed.

SPECIFICITY

• Specificity also called the true negative predictive rate (NPR) measures the proportion of actual negatives that are correctly identified. The percentage of healthy people who are correctly identified as not having the condition. Specificity avoids false positives.
# PRE-HOSPITAL STROKE SCALES

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>PPV</th>
<th>NPV (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cincinnati Prehospital Stroke Scale (CPSS) – (Face, Arm, Speech) 1997</td>
<td>Cincinnati, USA</td>
<td>72%v - 1/3 findings</td>
<td>(57-96)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>85% - if 3/3 findings</td>
<td></td>
</tr>
<tr>
<td>FAST – (Face, ARM, Speech, Time) 1998</td>
<td>Newcastle, UK</td>
<td>(73-98) - Range</td>
<td>(45-98) - Range</td>
</tr>
<tr>
<td>LA Prehospital Stroke Scale (LAPSS) 2000 (Hx of seizure, age ≥ 45,</td>
<td>Los Angeles, USA</td>
<td>91</td>
<td>97</td>
</tr>
<tr>
<td>pre-stroke baseline, BG 60-400, asymmetry-unilateral weakness)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PPV = Positive Predictive Value  
NPV = Negative Predictive Value

Annals of Emergency Medicine, 2014; 64 (5) 509-515.  
Emerg Med J. 2015;0:1-5 DOI:10.1136/emерmed-2015-205197
Screening criteria

1. Age over 45 years
2. No prior history of seizure disorder
3. New onset of neurological symptoms in last 24 hours
4. Patient was ambulatory at baseline (prior to event)
5. Blood glucose between 60 and 400

Exam criteria

Facial smile/grimace

Grip

Arm weakness

6. Based on exam, patient has only unilateral weakness
   If **YES** (or unknown) to all items above, LAPSS screening criteria met.
   If LAPSS criteria for stroke met, call receiving hospital with “code strok
BE-FAST (BALANCE, EYES, FACE, ARM, SPEECH, TIME)
BEFAST- REVIEW

- FAST identified 69% to 90% of strokes but missed up to 40% of those with posterior circulation events. *Int J Stroke. 2013;8:E3.*

- Rates improved with the addition of visual symptoms and limb ataxia, but ataxia can be difficult to identify. *J Neurol Neurosurg Psychiatry. 2012;83:228–229.*

- Some educational programs have used the mnemonic BE-FAST, adding a “B” for balance and an “E” for eyes, but supportive data are limited.

- A Systematic Review and Meta-Analysis Comparing FAST and BEFAST in Acute Stroke Patients
  - 9 studies – 6151 participants analyzed
  - Sensitivity of FAST was 0.77, specificity was 0.60
  - Sensitivity of BEFAST was 0.68, specificity was 0.85

Conclusions: Our findings indicated that FAST and BEFAST might be useful in the diagnosis of acute ischemic stroke. The diagnostic value of BEFAST in acute ischemic stroke was higher than in FAST; thus, it might have an important role in the fast recognition of acute ischemic stroke. *Front. Neurol., 28 January 2022*
STROKE SEVERITY SCALE

- Refers to a numerical scale used to determine the severity of the neurologic deficits once a stroke is suspected in order to identify patients with severe symptoms due to LVO that may benefit from EVT.

- There are several available tools, and no single tool has been shown to be superior. Each EMS region should choose a single screening tool and severity tool for use across all EMS providers.

- Why you can’t have a perfect scale:
  - Up to 29% of patient with baseline of NIHSS = 0 had a proximal occlusion on CTA
  - Most scales are subsets of NIHSS scores
  - Patients with ICH, post seizure paralysis, hyperglycemia in the field can have high NIHSS
Large Vessel Occlusion (LVO)

- Occlusion of any primary arteries of the brain

- **ICA**: Internal carotid arteries
- **MCA**: Middle cerebral arteries
- **ACA**: Anterior cerebral arteries
- **BA**: Basilar artery
- **PCA**: Posterior cerebral arteries

[Diagram showing various brain arteries labeled ICA, ACA, MCA, BA, PCA, VA, and other vessels like Skull, Brain outline, Spinal cord, Cervical vertebrae.]

Common carotid artery
ANATOMICAL CORRELATION TO DEFICIT

CONJUGATE EYE DEVIATION - LARGE INFARCTS
APHASIA AND NEGLECT ALONE WITHOUT MOTOR SYMPTOMS - HIGHLY SENSITIVE MARKERS FOR LVO (SENSITIVITY 0.91) AND EVT (SENSITIVITY 0.90)
IN COMBINATION WITH HEMIPARESIS LEADS TO A HIGHER SENSITIVITY (0.97)
NEGLECT SYMPTOMS ALONE ACHIEVE THE HIGHEST PPV FOR LVO
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Findings</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simple 3-item Stroke Scale</strong></td>
<td>Score of &gt; 4 predicted proximal LVO (Carotid T-segment or M1 segment occlusion of MCA)</td>
<td>80% Specificity 62% Sensitivity PPV – 21% NPV – 95%</td>
</tr>
<tr>
<td><strong>Locomotor Activity Scale (LAMS)</strong></td>
<td>Score ≥ 4 ↑ by 7-fold that a stroke patient harbors a LVO</td>
<td>93% Specificity 38% Sensitivity PPB – 28% NPV – 95%</td>
</tr>
<tr>
<td><strong>NIHSS</strong></td>
<td>Time dependent; anterior circulation ≥ 9 points within 3 hours ≥ 7 points within 3-6 hours Poor PPV for patients with posterior circulation strokes</td>
<td>Stroke. 2013; 44: 1153-1157 CCM Journal. 2016;44(6):e336-e343</td>
</tr>
<tr>
<td><strong>Rapid Arterial oCclusion Evaluation Scale (RACE)</strong></td>
<td>Score ≥ 5 Specificity = 0.68 Sensitivity = 0.85 PPV = 0.42 NPV = 0.94</td>
<td>Stroke. 2014; 45: 87-91</td>
</tr>
</tbody>
</table>
# PREDICTING EMERGENT LARGE VESSEL OCCLUSION (ELVO) STROKES

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Findings</th>
<th>Reference</th>
</tr>
</thead>
</table>
| **LEGS**  | NIHSS ≥ 10 correlate well with LVO  
LEGS score of ≥ 4 correlate well with NIHSS > 10 | Stroke. 2014; 45: ATMP59 |
| **CPSSS – Cincinnati Prehospital Stroke Severity Score – CSTAT** | 73% specific in identifying 89% sensitive NIHSS ≥ 15 | Stroke. 2015; 46: 1508-1512 |
| **VAN**   | Specificity 90%  
Sensitivity 100%  
PPV – 74%  
NPV 100% | J Neurointerventional Surg. 2016;0:1-5  
DOI:10.1136/neurintsurg-2015-012131 |
| **PASS – Prehospital Acute Stroke Severity** | PASS score ≥ 2 had median NIHSS =17; PASS score < 2 had median NIHSS = 6 | Stroke. 2016; 47: 00.00.  
DOI. 10.1161/STROKEAHA.115.012482 |
**F.A.S.T**
(To rule out a stroke)

**FACE**
- Is the face weak or drooping on one side?
- Ask the person to smile.

**ARMS**
- Is one arm weak or numb?
- Ask them to lift their arms; Does one arm drift downwards?

**SPEECH**
- Are they slurring their speech?
- Ask the person to repeat a simple sentence.
- Do they repeat it correctly?

**TIME**
- Time is important! How much time has passed?
- Call 9-1-1 IMMEDIATELY!

---

**The Los Angeles Motor Scale (LAMS) (Stroke severity)**

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial Droop</td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>1</td>
</tr>
<tr>
<td>Arm Drift</td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td>Drifts down</td>
<td>1</td>
</tr>
<tr>
<td>Falls rapidly</td>
<td>2</td>
</tr>
<tr>
<td>Grip Strength</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td>Weak grip</td>
<td>1</td>
</tr>
<tr>
<td>No grip</td>
<td>2</td>
</tr>
</tbody>
</table>

Total score: (0-5)
Score of 4-5 is possible ELVO

---

EMS TRANSPORT CRITERIA SHOULD BE SEVERITY AS WELL AS TIME BASED

1 or 2 points to the highest center within 15 minutes (likely a minor stroke and probably not a candidate for more aggressive therapy)

3-5 points, or any patient who is drowsy or has impaired consciousness goes to CSC (larger stroke that benefits from higher level of care)

Grotta et al., Stroke. 2013; 44:555-557
NIHSS – PREDICTING LVO

Validated across a variety of environments and providers

Gives data about severity and potentially location

NIHSS ≥ 6 identifies patients who should receive endovascular therapy (Class I, LOE A)

Can be utilized in selected Prehospital Providers

May be too complicated for generalized use

Limited assessment of posterior strokes - Unsteady gait, dizziness, or diplopia

2015 Stroke Endovascular Update
Rapid Arterial Occlusion Evaluation - RACE

1. Aim to develop and validate a simple prehospital stroke scale to predict the presence of large vessel occlusion (LVO) in patients with acute stroke.

2. Designed based on elements of the NIHSS
   - Focuses on facial palsy, extremity motor function, head and gaze deviation, and aphasia or agnosia.

3. Thought to be simpler to assess by field providers than a full NIHSS.

4. Scale - range is 0-9 points
   - RACE scale score >5 points is associated with detection of a LVO.
   - RACE has a sensitivity of 85% and specificity of 68%.

Pérez de la Ossa et al., 2014 Jan;45(1):87-91
**RACE**

**Aphasia (Right Hemiparesis)**
Evaluate if obeys
1. Close your eyes
2. Make a fist

**Agnosia (Left Hemiparesis)**
1. Ask the patient while showing him or her the paretic arm
   “Whose arm is this and evaluate
2. Can you lift both arms and clap

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

Score total: 0-9

Pérez de la Ossa et al., 2014 Jan;45(1):87-91
CINCINNATI PREHOSPITAL STROKE SEVERITY SCALE (CPSSS)

1. First published in 1997
   • Identifies facial paresis, arm drift, and abnormal speech.
   • 80% of stroke patients will exhibit one or more of these symptoms.
   • Does not identify posterior circulation strokes
   • Strength: Quick and easy for EMS to use

2. Score ranges from 0 to 4
   • 2 points: Conjugate gaze deviation
   • 1 point: Incorrectly answers at least one of LOC (age or current month) and does not follow at least one or two commands (close eyes, open and close hand)
   • 1 point: Cannot hold arm (R or L) up for 10 seconds before arm falls to bed

3. Score ≥2 was 89% sensitivity and 73% specificity in identifying NIHSS ≥15.
   Katz et al., Stroke. Jun;46(6):1508-12

Cincinnati Stroke Triage Assessment Tool - CSTAT

Li et al; Prehosp Emerg Care. 2020;24(4):500-504.
FIELD ASSESSMENT STROKE TRIAGE FOR EMERGENCY DESTINATION — FAST -ED

Three distinct groups for the likelihood of LVOS:
0-1: < 15%
2-3: ~ 30%
4-9: > 60% or higher

Large vessel occlusion assessment tools: VAN

So... what is VAN?

V V Vision
A Aphasia
N Neglect

Weakness PLUS...
Positive patients had 100% sensitivity, 90% specificity, (PPV) 74% and NPV 100% for detecting LVO.
FANG-D — DEVELOPED BY SAINT LUKE’S

**F** – Field cut – (PCA)

**A** – Aphasia – (L MCA)

**N** – Neglect – (R MCA)

**G** – Gaze Preference – (MCA, looks at stroke)

**D** – Dense Hemiparesis – (NIH ≥ 3 in any limb

Prospective study completed Department of Emergency Medical Center, Charlotte North Carolina. Study completed in the small hospital ED to help ED physicians in making transport decisions.

- Sensitivity of 91% - this exceeded RACE, FAST-ED and CPSS screening
- Specificity of 35%
- Substantial inter-rater reliability
- Limitations — missing data and how would it compare to out of hospital (field) screening and needs further validation

Credit on development to Dr. Karin Old, Dr. Naveed Akhtar, and Angie Hawkins

LIMITATIONS
LAMS

Pure Motor - No Vision Assessment

<table>
<thead>
<tr>
<th>Los Angeles Motor Scale (LAMS)²²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Face</strong></td>
</tr>
<tr>
<td>0  Both sides move normally</td>
</tr>
<tr>
<td>1  One side is weak or flaccid</td>
</tr>
<tr>
<td><strong>Arm</strong></td>
</tr>
<tr>
<td>0  Both sides move normally</td>
</tr>
<tr>
<td>1  One side is weak</td>
</tr>
<tr>
<td>2  One side is flaccid/doesn't move</td>
</tr>
<tr>
<td><strong>Grip</strong></td>
</tr>
<tr>
<td>0  Both sides move normally</td>
</tr>
<tr>
<td>1  One side is weak</td>
</tr>
<tr>
<td>2  One side is flaccid/doesn't move</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>0–5</td>
</tr>
</tbody>
</table>
LIMITATIONS
CINCINNATI PREHOSPITAL STROKE SEVERITY SCORE

Score ranges from 0 to 4
- 2 points: Conjugate gaze deviation
- 1 point: Incorrectly answers at least one of LOC (age or current month) and does not follow at least one or two commands (close eyes, open and close hand)
- 1 point: Cannot hold arm (R or L) up for 10 seconds before arm falls to bed

No Vision Assessment
LIMITATIONS

VAN

Only assesses arm weakness

Vision – field cut, blind
Aphasia – receptive or expressive
Neglect – forced gaze, sensory neglect
**Table 1. RACE Scale (Table view)**

<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>Performance 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 and the impairment</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Does not recognize his/her arm or the impairment</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Does not recognize his/her arm nor the impairment</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Score total</td>
<td>0–8</td>
<td></td>
</tr>
</tbody>
</table>
• Inaccurate localization occurs if rely on clinical neurologic deficits alone

• Crossed signs PLUS contralateral hemiplegia/hemianesthesia are specific—point to brainstem involvement

  | Crossed sensory deficits: medulla | Crossed motor deficits: medulla, pons, and midbrain |

• Disturbed consciousness in NOT highly specific for posterior circulation stroke
ADAM’S SCALE OF POSTERIOR STROKE (ASPOS)

Goal to develop a tool to assess and predict posterior strokes (20-40% of all ischemic strokes)

All other severity scales primarily assess anterior circulation

Posterior signs – LOC, gait/trunkal ataxia, vertical gaze palsy, nystagmus, and bulbar signs (swallowing)

---

### Adam’s Scale of Posterior Stroke (ASPOS)

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
</table>
| Reactivity | 0. concious  
|          | 1. somnolence, confusion  
|          | 2. sopor  
|          | 3. coma  |
| Eyes    | 0. normal eye movement and visual fields  
|          | 1. nystagmus, double vision, hemianopsia  
|          | 2. eye movement disturbances  
|          | 3. ophthalmoplegia, cortical blindness  |
| Pharynx | 0. normal swallowing, no dysarthria  
|          | 1. mild dysarthria  
|          | 2. moderate dysarthria, choking on liquids  
|          | 3. anarthria, choking on solid foods, nasogastric tube  |
| Strength| 0. without motor deficit of limbs or face  
|          | 1. mild motor deficit of limbs or face  
|          | 2. moderate/severe motor deficit of limbs or face  
|          | 3. limb paralysis  |
| Balance | 0. Romberg’s attempt negative, normal gait  |

*Wisniewski et al, Brain Sciences, 2021:11(4).*
Expanded NIHSS (E-NIHSS) 4


Comparison: Item 4

**Horizontal eye movements**
- 0 = normal
- 1 = partial gaze palsy (gaze is abnormal in 1 or both eyes, but forced deviation or total gaze paresis is not present)
- 2 = forced deviation or total gaze (paresis not overcome by the oculocephalic maneuver)

**Horizontal and vertical eye movements**
- 0 = normal
- 1 = partial gaze palsy (gaze is abnormal in 1 or both eyes, but forced deviation or total gaze paresis is not present)
- 1 = nystagmus and/or Horner’s syndrome
- 2 = forced deviation or total gaze (paresis not overcome by the oculocephalic maneuver)
### EXPANDED NIHSS (E-NIHSS) 6

Olivata et al. Journal of Stroke and Cerebrovascular
2016 Dec;25(12):2953-2957.

<table>
<thead>
<tr>
<th>Comparison: Item 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facial palsy</strong></td>
</tr>
<tr>
<td>0 = normal</td>
</tr>
<tr>
<td>1 = minor paralysis (flattened nasolabial fold, asymmetry on smiling)</td>
</tr>
<tr>
<td>2 = partial paralysis (total or near-total paralysis of the lower face)</td>
</tr>
<tr>
<td>3 = complete paralysis of 1 or both sides (absence of facial movement in the upper and lower parts of the face)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facial, hypoglossal and glossopharyngeal palsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = normal</td>
</tr>
<tr>
<td>1 = minor paralysis (flattened nasolabial fold, asymmetry on smiling)</td>
</tr>
<tr>
<td>2 = partial paralysis (total or near-total paralysis of the lower face)</td>
</tr>
<tr>
<td>3 = complete paralysis of 1 or both sides (absence of facial movement in the upper and lower parts of the face)</td>
</tr>
<tr>
<td>3 = deficit of IX nerve (soft palate paralysis)</td>
</tr>
<tr>
<td>3 = deficit of XII nerve</td>
</tr>
</tbody>
</table>
**EXPANDED NIHSS (E-NIHSS) 11**

Olivata et al. Journal of Stroke and Cerebrovascular
2016 Dec;25(12):2953-2957.

## Comparison: Item 11

<table>
<thead>
<tr>
<th>Limb ataxia</th>
<th>Limb and trunk ataxia</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0 = absent or untestable</td>
<td>• 0 = absent or untestable</td>
</tr>
<tr>
<td>• 1 = present in 1 limb</td>
<td>• 1 = present in 1 limb</td>
</tr>
<tr>
<td>• 2 = present in 2 limbs</td>
<td>• 1 = imbalance in Romberg position</td>
</tr>
<tr>
<td></td>
<td>• 2 = present in 2 limbs</td>
</tr>
<tr>
<td></td>
<td>• 2 = trunk ataxia or retro- or lateropulsion</td>
</tr>
</tbody>
</table>
CASE STUDY 1

• 67-year-old right-handed male

• Sudden onset right arm weakness while eating breakfast at 6:30 wife immediately called 911

• Transported to the local PSC hospital

• IV alteplase administered at 07:45

• Notified CSC and asked to accept patient as a drip and ship
  – No formal LVO scale completed

• Arrival to CSC 09:15, NIH 6 on arrival - since was 6 notified INR team of possible intervention and a CTA/CTP head and completed
CASE STUDY 1 INITIAL CT HEAD

Initial Head Non-Contrast CT at PSC hospital
Negative – no acute infarct
# NATIONAL INSTITUTES OF HEALTH STROKE SCALE

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A Level Of Consciousness</td>
<td>0</td>
</tr>
<tr>
<td>1B Level Of Consciousness Questions</td>
<td>0</td>
</tr>
<tr>
<td>1C Level Of Consciousness Commands</td>
<td>0</td>
</tr>
<tr>
<td>2 Best Gaze</td>
<td>0</td>
</tr>
<tr>
<td>3 Visual fields</td>
<td>1</td>
</tr>
<tr>
<td>4 Facial palsy (pareisis)</td>
<td>1 Face weak (1)</td>
</tr>
<tr>
<td>5A Motor—Left arm</td>
<td>0</td>
</tr>
<tr>
<td>5B Motor—Right arm</td>
<td>1 Arm weak but no flaccid (0)</td>
</tr>
<tr>
<td>6A Motor—Left leg</td>
<td>0</td>
</tr>
<tr>
<td>6B Motor—Right leg</td>
<td>1</td>
</tr>
<tr>
<td>7 Limb Ataxia</td>
<td>0</td>
</tr>
<tr>
<td>8 Sensory</td>
<td>1</td>
</tr>
<tr>
<td>9 Best Language</td>
<td>1</td>
</tr>
<tr>
<td>10 Dysarthria (articulation of words)</td>
<td>0</td>
</tr>
<tr>
<td>11 Extinction</td>
<td>0</td>
</tr>
</tbody>
</table>

Score 6

**Los Angeles Motor Scale (LAMS)**

<table>
<thead>
<tr>
<th>Los Angeles Motor Scale (LAMS)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face 0</td>
<td>Both sides move normally</td>
</tr>
<tr>
<td>Face 1</td>
<td>One side is weak or flaccid</td>
</tr>
<tr>
<td>Arm 0</td>
<td>Both sides move normally</td>
</tr>
<tr>
<td>Arm 1</td>
<td>One side is weak</td>
</tr>
<tr>
<td>Arm 2</td>
<td>One side is flaccid/doesn't move</td>
</tr>
<tr>
<td>Grip 0</td>
<td>Both sides move normally</td>
</tr>
<tr>
<td>Grip 1</td>
<td>One side is weak</td>
</tr>
<tr>
<td>Grip 2</td>
<td>One side is flaccid/doesn't move</td>
</tr>
</tbody>
</table>

Grip with both hands
Score ≥ 4 ↑ by 7-fold that a stroke patient has a LVO
Small core infarction and moderate area of penumbra within the left temporal occipital region consistent with a distal left PCA P3/P4 branch occlusion.

The left P1 and P2 segments are patent, and the definite site of arterial occlusion is not visualized by CT angiography.
CASE STUDY 1

No large vessel occlusion established

Notified ICU of patient – handoff report provided

Patient admitted to ICU for follow up status/post IV Alteplase care
Cincinnati Prehospital Stroke Severity Scale (CPSSS)

Conjugate gaze deviation = 2
Level of Consciousness = 1

Incorrectly answers at least one of the following:
- How old are you?
- What month is it?

AND

Does not follow at least one of two commands:
- Close your eyes.
- Open and close your hand (non-paretic)

Motor = 1
Cannot hold arm (right, left or both) for up to 10 s before arm falls onto bed.

LVO is likely if score ≥ 2.

Score 1

Rapid Arterial oCclusion Evaluation (RACE)

Facial palsy - weakness on one side of face with smile.
- Absent = 0
- Mild (some facial movement) = 1
- Moderate to severe (little to no facial movement) = 2

Arm motor function - the same test as Cincinnati and Los Angeles scales.
- Normal to mild = 0
- Moderate (able to lift arm, but unable to hold it for 10 seconds) = 1
- Severe (unable to raise arm) = 2

Leg motor function - ask the patient to lift each leg.
- Normal to mild (able to lift leg and hold for five seconds) = 0
- Moderate (able to lift, but unable to hold for five seconds) = 1
- Severe (unable to lift one leg off of bed at all) = 2

Head and gaze deviation - if the patient’s head or eyes are towards one side, ask them to look towards the other side.
- Absent = 0
- Present (unable shift gaze past midline) = 1

If a right-side deficit is found, check for aphasia (inability to say or hear words correctly). Ask the patient to close their eyes and make a fist.
- Performs both tasks correctly = 0
- Performs 1 task correctly = 1
- Performs neither task = 2

If a left-side deficit is found, check for agnosia (an inability to process sensory information). Touch their arm and ask “whose arm is this?”
- Then ask them to raise both hands and clap.
- Patient recognizes his/her arm = 0
- Does not recognize his/her arm or the impairment = 1
- Does not recognize his/her arm nor the impairment = 2

If a deficit is found, LVO is likely if the cumulative score is above 5.

Score 3

Field Assessment Stroke Triage for Emergency Destination (FAST-ED)

Facial palsy - weakness on one side of face with smile.
- Absent or minor paralysis = 0
- Partial or complete paralysis = 1

Arm weakness
- No drift = 0
- Drift or some effort against gravity = 1
- No effort against gravity or no movement = 2

Speech changes
- Absent = 0
- Mild to moderate = 1
- Severe, global aphasia or mute = 2

Eye deviation
- Absent = 0
- Partial = 1
- Forced deviation = 2

Neglect
- Absent = 0
- Extinction to bilateral simultaneous stimulation in only one sensory modality = 1
- Does not recognize own hand or only orients to one side of the body = 2

LVO is likely if FAST-ED ≥ 4.

Score 3
CASE STUDY 2

• 58-year-old male awoke at 6:00 and was at work by 7:00. Co-workers had witnessed patient and seemed normal that AM

• Found sitting on a pallet at 9:00 and when co-worker attempted to find out what was wrong – co-worker questioned patient and speech was gibberish, he noted left sided facial droop and arm weakness.

• 911 called and transported to nearby PSC since it was 3 hours and 45 minutes since last known well – since it was unwitnessed

• Co-worker notified wife
CASE STUDY 2

Arrival to PSC at 9:45 – last known well was at 6:00 AM

Time of onset 9:15 PM

NIH stroke score – 13 at PSC hospital
  • Stat CT Head negative
  • Glucose 98
  • No warfarin
## NATIONAL INSTITUTES OF HEALTH STROKE SCALE

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1A</strong> Level Of Consciousness</td>
<td>0</td>
</tr>
<tr>
<td><strong>1B</strong> Level Of Consciousness Questions</td>
<td>1</td>
</tr>
<tr>
<td><strong>1C</strong> Level Of Consciousness Commands</td>
<td>0</td>
</tr>
<tr>
<td><strong>2</strong> Best Gaze</td>
<td>1</td>
</tr>
<tr>
<td><strong>3</strong> Visual fields</td>
<td>1</td>
</tr>
<tr>
<td><strong>4</strong> Facial palsy (paresis)</td>
<td>2</td>
</tr>
<tr>
<td><strong>5A</strong> Motor–Left arm</td>
<td>3</td>
</tr>
<tr>
<td><strong>5B</strong> Motor–Right arm</td>
<td>0</td>
</tr>
<tr>
<td><strong>6A</strong> Motor–Left leg</td>
<td>1</td>
</tr>
<tr>
<td><strong>6B</strong> Motor–Right leg</td>
<td>0</td>
</tr>
<tr>
<td><strong>7</strong> Limb Ataxia</td>
<td>0</td>
</tr>
<tr>
<td><strong>8</strong> Sensory</td>
<td>2</td>
</tr>
<tr>
<td><strong>9</strong> Best Language</td>
<td>0</td>
</tr>
<tr>
<td><strong>10</strong> Dysarthria (articulation of words)</td>
<td>1</td>
</tr>
<tr>
<td><strong>11</strong> Extinction</td>
<td>1</td>
</tr>
</tbody>
</table>

Score 13
**Cincinnati Prehospital Stroke Severity Scale (CPSSS)**

- **Conjugate gaze deviation** = 2
- **Level of Consciousness** = 1
- Incorrectly answers at least one of the following:
  - How old are you?
  - What month is it?
  - AND
- Does not follow at least one of two commands:
  - Close your eyes.
  - Open and close your hand (non-paralitic)
- **Motor = 1**
  - Cannot hold arm (right, left or both) for up to 10 s before arm falls onto bed
  - LVO is likely if score ≥ 2

**Score 4**

---

**Rapid Arterial Occlusion Evaluation (RACE)**

- **Facial palsy** - weakness on one side of the face with smile.
  - Absent = 0
  - Mild (some facial movement) = 1
  - Moderate to severe (little to no facial movement) = 2

- **Arm motor function** - the same test as Cincinnati and Los Angeles scales.
  - Normal = 0
  - Severe (unable to raise arm) = 2
  - Moderate to severe (able to lift arm, but unable to hold it for 10 seconds) = 1

- **Leg motor function** - ask the patient to lift each leg.
  - Normal = 0
  - Severe (unable to lift one leg off of bed at all) = 2

- **Head and gaze deviation** - if the patient’s head or eyes are towards one side, ask them to look towards the other side.
  - Absent = 0
  - Present (unable shift gaze past midline) = 1

- **If a right-side deficit is found, check for aphasia (inability to say or hear words correctly).**

  - Ask the patient to close their eyes and make a fist.
  - Performs both tasks correctly = 0
  - Performs 1 task correctly = 1
  - Performs neither task = 2

- **If a left-side deficit is found, check for agnosia (an inability to process sensory information).**

  - Ask them to raise both hands and clap.
  - Patient recognizes his/her arm = 0
  - Does not recognize his/her arm or the impairment = 1
  - Does not recognize his/her arm nor the impairment = 2

**Score 5**

---

**Field Assessment Stroke Triage for Emergency Destination (FAST-ED)**

- **Facial palsy** - weakness on one side of the face with smile.
  - Absent or minor paralysis = 0
  - Partial or complete paralysis = 1

- **Arm weakness**
  - No drift = 0
  - Drift or some effort against gravity = 1
  - No effort against gravity or no movement = 2

- **Speech changes**
  - Absent = 0
  - Mild to moderate = 1
  - Severe, global aphasia or mute = 2

- **Eye deviation**
  - Absent = 0
  - Partial = 1
  - Forced deviation = 2

- **Denial/Neglect**
  - Absent = 0
  - Extinction to bilateral simultaneous stimulation in only one sensory modality = 1
  - Does not recognize own hand or only orients to one side of the body = 2

**LVO is likely if FAST-ED ≥ 4.**

**Score 6**
CASE STUDY 2

• IV Alteplase administered at urban PSC – without endovascular ability – NIH remained 13 and there was a high suspicion of LVO

• PSC notified CSC of transport and ETA

• CSC – notified stroke team and endovascular team of suspected LVO

• Upon arrival
  – NIHSS – 16
  – CTA and CTP completed
CT Perfusion  CT Angio
CASE STUDY 3

• 63-year-old right-handed male
• Time of onset 10:00 pm when went to bed
• Patient did not show up to work – notified daughter at 0700 and she went to house and found father in bed with stroke symptoms (dysarthria, left hemiplegia and right gaze preference)
• 0911 called at 07:30 patient outside the IV alteplase window
• EMS completed a LVO assessment – highly suspicious of LVO
• EMS notified small hospital – determined to call for helicopter and take to CSC.
• CSC notified Acute stroke team and interventional team.
• Upon arrival
  – NIH 16
  – Acute stroke work-up
  – Stat CT
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level Of Consciousness</strong></td>
<td>0</td>
</tr>
<tr>
<td><em>Questions</em></td>
<td>1</td>
</tr>
<tr>
<td><strong>Level Of Consciousness</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Commands</strong></td>
<td></td>
</tr>
<tr>
<td>Best Gaze</td>
<td>2</td>
</tr>
<tr>
<td>Visual fields</td>
<td>2</td>
</tr>
<tr>
<td>Facial palsy (pareisis)</td>
<td>2</td>
</tr>
<tr>
<td>Motor—Left arm</td>
<td>2</td>
</tr>
<tr>
<td>Motor—Right arm</td>
<td>0</td>
</tr>
<tr>
<td>Motor—Left leg</td>
<td>2</td>
</tr>
<tr>
<td>Motor—Right leg</td>
<td>0</td>
</tr>
<tr>
<td>Limb Ataxia</td>
<td>0</td>
</tr>
<tr>
<td>Sensory</td>
<td>2</td>
</tr>
<tr>
<td>Best Language</td>
<td>0</td>
</tr>
<tr>
<td>Dysarthria (articulation of words)</td>
<td>1</td>
</tr>
<tr>
<td>Extinction</td>
<td>2</td>
</tr>
</tbody>
</table>

Score: 16

---

**Rapid Arterial Occlusion Evaluation (RACE)**

**Facial palsy** - weakness on one side of face with smile.  
- Absent = 0  
- Mild (some facial movement) = 1  
- Moderate to severe (little to no facial movement) = 2

**Arm motor function** - the same test as Cincinnati and Los Angeles scales.  
- Normal = 0  
- Mild (able to lift arm, but unable to hold it for 10 seconds) = 1  
- Moderate (able to lift, but unable to hold for 5 seconds) = 1  
- Severe (unable to lift one arm, but able to hold other arm) = 2

**Leg motor function** - ask the patient to lift each leg.  
- Normal = 0  
- Mild (able to lift and hold for five seconds) = 0  
- Moderate (able to lift, but unable to hold for five seconds) = 1  
- Severe (unable to lift one leg off of bed at all) = 2

**Head and gaze deviation** - if the patient's head or eyes are towards one side, ask them to look towards the other side.  
- Absent = 0  
- Present (unable shift gaze past midline) = 1

If a right-side deficit is found, check for **aphasia** (inability to say or hear words correctly). Ask the patient to close their eyes and make a fist.  
- Performs both tasks correctly = 0  
- Performs 1 task correctly = 1  
- Performs neither task = 2

If a left-side deficit is found, check for **agnosia** (an inability to process sensory information). Touch their arm and ask “whose arm is this?” Then ask them to raise both hands and clap.  
- Patient recognizes his/her arm = 0  
- Does not recognize his/her arm or the impairment = 1  
- Does not recognize his/her arm nor the impairment = 2

LVO is likely if the cumulative score is above 5.  

Score 7
CASE STUDY 3 - INITIAL CT HEAD — NEGATIVE — OLD LACUNAR ON THE RIGHT

Not a candidate for IV alteplase
CASE STUDY 3 – CTA

Right M1 MCA Occlusion
Changes of the anterior medial temporal and insular cortices, findings indicative of acute infarct.

Large mismatched perfusion defect with penumbra.
CASE STUDY 3

CTA/CTP showed LVO

Intervention team at bedside
  ▪ Evaluating patient
  ▪ Intervention recommended
  ▪ Family/patient education

Taken to intervention - handoff report to endovascular team and ICU
Rural Acute Stroke (RAS) Measures

- Time to Intravenous Thrombolytic Therapy ≤ 60 minutes
- Door-In/Door-Out Time at First Hospital Prior to Transfer for Acute Therapy ≤ 90 Minutes
- National Institutes of Health Stroke Scale (NIHSS) Reported
- Door to CT ≤ 25 Minutes
  - Dysphagia Screen
- Documentation of Last Known Well or Time of Discovery of Stroke Symptoms
  - IV Thrombolytic Therapy Arrive by 3.5 Hours Treat by 4.5 Hours
- EMS Pre-notification
- Non-Contrast Brain CT or MRI Interpreted Within 45 Minutes of Arrival
- Telesstroke Consultation Done

Stars indicate measures that were previously recognized as reporting measures.
REFERENCES — STROKE PREHOSPITAL SCREENING


REFERENCES — STROKE SEVERITY SCALES


THANK YOU
Always Questions
Not Always Answers

dsummers@saint-lukes.org