Code Stroke!!

Amit Kansara, MD, FAHA

Joint EMS Conference
Providence Brain and Spine Institute
Providence Heart and Vascular Institute

February 22, 2019
• 20:45: You are dispatched to the home of a 69 year-old man who was heard by wife to collapse in another room. He’s alert, but not speaking normally and she can’t get him off the ground.

• 20:55: Arrive on scene. What do you want to know?
Patient History: On-scene Evaluation

• Wife last saw him normal when he finished dinner and went to the other room to watch TV.

• He is alert, following commands, having trouble finding some words but is oriented to month, age, sitting up but slumped to the right. He has R facial droop and is trying to help you get him to gurney, reaching ineffectively with his R arm, and only partially bearing weight on R leg.

• BP is 197/110. Pulse is 110, irregular. Wife confirms that he has atrial fibrillation.

• What more do you want to know?
Need to know

• CLOCK TIME last known normal?
  – ask clarifying questions
• Anticoagulation medications
  – Medication name and when last dose taken
What is patient’s diagnosis?

a. Acute ischemic stroke  
b. Brain hemorrhage  
c. Transient Ischemic Attack (TIA)  
d. Seizure
Patient History: Drive

• 21:05: Clear scene.

You are 7 min from a Stroke Ready Hospital and 25 min from an interventional capable center. Where do you go?
  --C-STAT status (what is C-STAT in our patient?)

• 21:07: Prenotify receiving Hospital
  – Acute stroke patient
  – LKN (last known normal)
Patient History: Door

• 21:12: Arrive at Stroke Ready hospital
• 21:13: Rapid ED MD assessment
• 21:15: on way to CT, patient suddenly becomes hemiplegic to R with L forced gaze deviation
Stroke Statistics: Leading cause of disability and 5th leading cause of death

The decline in stroke deaths has slowed since 2013.

Stroke death declines have stalled in 3 out of every 4 states.

CONTINUED = death rates continued to decrease steadily from 2000-2015 in adults 35 years and older
SLOWED = the decrease in death rates slowed down over time
REVERSED = the death rates reversed from decreasing to increasing
Common stroke symptoms

Right Hemispheric Stroke
- Slurred speech - dysarthria
- Weakness or numbness of left face, arm or leg
- Left sided neglect
- Right gaze preference

Left Hemispheric Stroke
- Speech problems – what is being said or inability to get words out
- Problems with comprehension
- Weakness or numbness of right face, arm, or leg
- Left gaze preference

Brainstem Stroke Symptoms
- Nausea, vomiting or vertigo
- Speech problems
- Swallowing problems
- Abnormal eye movements
- Decreased consciousness
- Crossed findings

Intracerebral Hemorrhage

Intraparenchymal Hemorrhage
- Nausea and Vomiting
- Headache
- One Sided Weakness
- Decreased Consciousness

Subarachnoid Hemorrhage
- Worst Headache of Life
- Intolerance to Light
- Neck Stiffness or Pain

Posterior circulation stroke

- Wide range of non-specific symptoms
- 1/3 initially misdiagnosed
- New vertigo or disequilibrium or dizziness, and those with new headache, neck pain or changed migraine
- Nausea
- Vomiting
- Not able to BALANCE sitting or standing
Recognize and Respond to STROKE

BEFAST

IS FOR BALANCE: Does the person have a sudden loss of balance?

IS FOR EYES: Has the person suddenly lost their vision, have double vision, or blurry vision?

IS FOR FACE: Does the person’s face suddenly look uneven?

IS FOR ARM: Is one arm suddenly weak or hanging down?

IS FOR SPEECH: Is the person suddenly having trouble speaking, slurred speech or a hard time understanding?

IS FOR TIME: TIME TO CALL A CODE STROKE!
# Local EMS Treatment Protocol Stroke/CVA 2019

## 1. Portland Prehospital Stroke Screen

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age over 45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. No prior history of seizure disorder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. New onset of neurologic symptoms in last 24 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Patient was ambulatory at baseline (prior to event)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. CBG between 60 &amp; 400</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Neurological Examination

<table>
<thead>
<tr>
<th>Examination</th>
<th>Normal</th>
<th>Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial smile/grimace (ask patient to smile/show teeth)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal: Both sides of face move equally well</td>
<td>Yes</td>
<td>Right</td>
</tr>
<tr>
<td>Abnormal: One side of face does not move as well as the other</td>
<td></td>
<td>Left</td>
</tr>
<tr>
<td>Arm drift (patient closes eyes and hold both arms out palms up)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal: Both arms move the same or do not move at all</td>
<td>Yes</td>
<td>Right</td>
</tr>
<tr>
<td>Abnormal: One arm does not move or drifts down compared to other</td>
<td></td>
<td>Left</td>
</tr>
<tr>
<td>Hand grip (have patient squeeze both hands simultaneously)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal: Equal grip strength</td>
<td>Yes</td>
<td>Right</td>
</tr>
<tr>
<td>Abnormal: Unequal grip strength</td>
<td></td>
<td>Left</td>
</tr>
<tr>
<td>Speech (have patient repeat a simple phrase such as “You can’t teach an old dog new tricks”)</td>
<td>Normal/Abnormal</td>
<td></td>
</tr>
<tr>
<td>Normal: No difficulty repeating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal: Patient has difficulty finding words, may speak in long meaningless sentences and/or cannot understand or follow simple verbal instructions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If questions 1 – 5 are all answered “Yes” or “Unknown” and at least 1 of the 4 neurological examination findings are abnormal, the patient is considered to have a POSITIVE screen. Continue to C-STAT evaluation.
Local EMS treatment protocol stroke/CVA 2019

**C-STAT – CINCINNATI STROKE TRIAGE ASSESSMENT TOOL**

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gaze Preference</strong> – Deviation of eyes away from side of weakness, toward side of stroke.</td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>2</td>
</tr>
<tr>
<td><strong>Arm Weakness</strong> - Cannot hold up arm(s) for 10 seconds</td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>1</td>
</tr>
<tr>
<td><strong>Level of Consciousness</strong> - Incorrectly answers at least one of two LOC questions AND does not follow at least one of two commands.</td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>1</td>
</tr>
</tbody>
</table>

***** POSITIVE C-STAT SCORE IS ≥ 2 *****

Other scales: RACE, FAST ED, VAN, sNIHSS, LAMS
CSTAT score sensitivity and specificity

Table 1. Accuracy of Cincinnati Prehospital Stroke Severity Scale (CPSSS) ≥2 in Detecting Moderate/Severe Stroke and LVO

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Data Set</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PLR</th>
<th>NLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe (NIHSS≥15)</td>
<td>Derivation</td>
<td>89%</td>
<td>73%</td>
<td>3.30</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Validation</td>
<td>92%</td>
<td>51%</td>
<td>1.89</td>
<td>0.16</td>
</tr>
<tr>
<td>Moderate (NIHSS≥10)</td>
<td>Derivation</td>
<td>75%</td>
<td>85%</td>
<td>5.00</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>Validation</td>
<td>79%</td>
<td>89%</td>
<td>7.18</td>
<td>0.24</td>
</tr>
<tr>
<td>LVO</td>
<td>Validation</td>
<td>83%</td>
<td>40%</td>
<td>1.38</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Table 2. Comparison of CPSSS to Other Published Prehospital Stroke Severity Scales

<table>
<thead>
<tr>
<th></th>
<th>CPSSS</th>
<th>LAMS</th>
<th>RACE</th>
<th>I3SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derivation data set (n)</td>
<td>624</td>
<td>119</td>
<td>654</td>
<td>171</td>
</tr>
<tr>
<td>Validated in independent data set (Y/N)</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>No. of items scored</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity/specificity for severe stroke</td>
<td>89%/72%</td>
<td>NA</td>
<td>NA</td>
<td>86%/95%*</td>
</tr>
<tr>
<td>Sensitivity/specificity for LVO</td>
<td>83%/40%</td>
<td>81%/89%†</td>
<td>85%/67%‡</td>
<td>67%/92%§</td>
</tr>
<tr>
<td>Evaluated in prehospital setting (Y/N)</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

Katz et al, Stroke. 2015;46:1508–1512
What happens before and after patient arrives to ED

- Pre notification to stroke team
- ETA, CSTAT positive/negative
- Code stroke zone or ED assigned area/room
- Quick information exchange with ED MD, stroke MD (either on site or on telerobot)
- Brief neuro exam and rush to CT/CTA and CTP (when LKW > 6 hours or wake up stroke)
Effect of pre-notification on stroke treatment times

- Early stroke team activation
- Reduce door to CT times
- Reduce door to IV alteplase times
- Reduce door to groin puncture times for mechanical thrombectomy

- Bhatt et al, Target Stroke: Best Practice Strategies Cut Door to Thrombolysis Time to <30 Minutes in a Large Urban Academic Comprehensive Stroke Center, The neurohospitalist, 2019
- Abboud et al, Recognition of Stroke by EMS is Associated with Improvement in Emergency Department Quality Measures, Prehospital emergency care, 2016
- Grover et al, EMS and Acute Stroke Care: Evidence for Policies to Reduce Delays to Definitive Treatments, Current Cardiovascular risk reports, 2016
Acute ischemic stroke treatment: Evolution

IV TPA up to 3 hours (NINDS IV TPA) 1995

IV TPA up to 4.5 hours (ECASS III) 2008

Clot retrieval up to 6 hours (MR CLEAN, SWIFT PRIME, ESCAPE, EXTEND IA, REVASCAT trials) 2015

Extended time window of treatment up to 24 hours (DAWN and DEFUSE III) 2018
Options to get that artery OPEN

• IV Alteplase (tPA) in MOST patients up to 4.5 hours
  – Limit is 3 hours in a very few high-risk patients
  – Available, quickly, at almost every hospital in OR, via telemedicine

• Mechanical Embolectomy
  – Limit is imaging, rather than time, dependent
  – Available at multiple Portland hospitals, Medford and Eugene
From: *Time to Treatment With Intravenous Tissue Plasminogen Activator and Outcome From Acute Ischemic Stroke*


5404 patients in the 0 to 90-min, 45,029 in the 91- to 180-min, and 7920 in the 181- to 270-minute time window. SNF indicates skilled nursing facility.

- Faster treatment saves lives and reduces disability!
- *For every 15 minutes saved:*
  - Fewer patients die
  - Fewer patients bleed
  - More patients go home
  - More patients are independent at discharge (walking and talking)
Basics of cerebral circulation
Mechanical Embolectomy of L Middle Cerebral Artery

Diagnostic angiogram
Confirms embolism

Stent deployed- left open

Stent and embolism retrieved; MCA flow restored; less flow to ACA as flow diverted to injured brain
ED response times, treatment times
- Early C STAT notification
- Early stroke MD response time
- Better outcome

**Stroke Patient Time Tracker**

<table>
<thead>
<tr>
<th>Site: PPMC</th>
<th>Actual Time</th>
<th>Goal Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED Arrival: 9/7/2018 12:12:00 PM</td>
<td>-2</td>
<td>10</td>
</tr>
<tr>
<td>MRN (database ID): 29013010033</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Initials: CF</td>
<td>Door to STROKE MD PAGE</td>
<td></td>
</tr>
<tr>
<td>LKW: 9/7/2018 11:45:00 AM</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>EMS Arrival? Yes</td>
<td>Door to STROKE MD ARRIVAL / BEAM-IN</td>
<td></td>
</tr>
<tr>
<td>CSTAT Positive? Yes</td>
<td>Door to CT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door to ALTEPLASE ORDER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALTEPLASE ORDER to READY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door to NEEDLE</td>
<td></td>
</tr>
<tr>
<td>Stroke MD: Yanase</td>
<td>Door to GROIN PUNCTURE</td>
<td>48</td>
</tr>
<tr>
<td>Beam.in: No</td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>

**Comments:**
Patient is an 89yr old male who developed sudden onset of aphasia and right sided weakness, NIHSS=20. Pt came in via EMS as CSTAT+, CTA=left MCA occlusion. Pt transferred to CVL for thrombectomy with solitaire x1 pass, post TICI=3 (complete recanalization). Great job team! NEW RECORD DTG 48min!!!!

Pt discharged home 9/9/18 with NIHSS=1! Great outcome!
Brain perfusion study

Volume of Ischemic Core, 23 ml
Volume of Perfusion Lesion, 128 ml

Mismatch volume, 105 ml
Mismatch ratio, 5.6
Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct

Advanced imaging can select patients for thrombectomy 6-24 hours from last normal.

- Two recent RCTs
  - CT Perfusion, or MRI/MR perfusion to select patients with salvageable brain tissue, despite prolonged time from last normal
  - Randomized to thrombectomy vs no-thrombectomy
  - Both trials showed *large* benefit for thrombectomy
    - DAWN Trial: Good outcome (mRS 0-2) in 49% vs. 13%
    - DEFUSE 3 Trial: Good outcome (mRS 0-2) in 45% vs. 17%
## Common stroke mimics

<table>
<thead>
<tr>
<th>STROKE MIMICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol Intoxication</td>
</tr>
<tr>
<td>Cerebral Infections</td>
</tr>
<tr>
<td>Drug Overdose/Toxicity</td>
</tr>
<tr>
<td>Epidural Hematoma</td>
</tr>
<tr>
<td>Hypoglycemia</td>
</tr>
<tr>
<td>Metabolic Disorders</td>
</tr>
<tr>
<td>Migraines</td>
</tr>
<tr>
<td>Neuropathies (Bell’s Palsy)</td>
</tr>
<tr>
<td>Seizure and post seizure, Todd’s Paralysis</td>
</tr>
<tr>
<td>Brain Tumors</td>
</tr>
<tr>
<td>Hypertensive Encephalopathy</td>
</tr>
</tbody>
</table>

Case 1: 56 year old female

- Onset: 8.50 am
- Symptoms: Left facial droop, left arm and leg weakness, dysarthria
- ED time: 9.31 am
- NIHSS 4 on arrival
- Seen on CT table at 9.40 am
- NIHSS 1
- Return to ED room- improved
- But…..
Case 1: 56 year old female

- In 10 mins, she became symptomatic again with NIHSS 3
- Still mild symptoms with mild facial droop, left sided paresthesia and mild dysarthria
- Treat or no treat?

1. Treat with tpa
2. No tpa due to mild symptoms
3. Rapid MRI
4. CT perfusion study
Case 1: 56 year old female

- Decided to treat with iv tpa but….
- Improved by the time tpa arrived
- Asked nurse to keep close watch
- In 10 mins, nurse called back that she was symptomatic again
- Gave tpa at 10.38 am
- Her NIHSS after 3 days- 6
Case 2: 78 F left hemiplegia

• Onset: 16.50
• ED time: 17.18
• CT head time: 17.28
• NIHSS: 17, rt gaze deviation, left hemiplegia
Case 2: 78 F left hemiplegia

- IV TPA time: 17.44
- Groin puncture time: 18.15
- Recanalization time: 18.50
- Discharge: mild left facial droop
- Work up: Negative initial cardiac monitoring, has implantable loop monitoring device inserted
Case 3: 93 F, Left hemiplegia, rt gaze deviation

- LKW: 12 am
- Time to ED, PPMC: 9.10, EMS prenotification with CSTAT positive
- Symptoms: Left hemiplegia, rt gaze deviation, dysarthria, NIHSS 21, h/o a fib not on OAC
- Time to cath lab: 10.23, groin puncture: 10.38
TICI 2a recanalization
Discharge MRS 4
Case 4: 76 F, woke up with dizziness, rt hand incoordination

- Onset: LKW 0200
- ED arrival- PWF: 0917
- Symptoms: Woke up with dizziness, right hand incoordination.
- ED exam: Mild rt facial droop, rt hand dysmetria, mild gait ataxia.

What do you think?
1) Cortical stroke
2) Small vessel disease stroke
3) Anterior circulation stroke
4) Posterior circulation stroke
Outcome: discharge
NIHSS 0, mild ataxia in rt arm
Case 5: 58 M, woke up with expressive aphasia

• Onset: LKW 12 am, woke up around 10 am with expressive aphasia
• ED arrival: Brought in private vehicle to PMH at 10.42
• Stat CT/CTA, NIHSS 9, telestroke examination by stroke MD from PPMC
• CTA: left ICA near occlusion and left M1 occlusion
• Transfer to PPMC, cath lab time 12.35 with groin puncture time 12.45
Outcome: MRS 1 at 6 months, only mild speech difficulty
Treatment and Routing Options
Triage to PSC or CSC?
ISC 2019 Session: “One Size Fits All? Models for Thrombectomy Systems of Care”

• With LVO, tPA recanalization rate is 10-20%
• Thrombectomy recanalization rate is 70-85%
• 20-25% stroke are LVO (10% eligible for thrombectomy)

• Over triaging to CSC
• Low specificity of CSTAT score
• Patient may fall out of iv tpa window
• Maturity of systems, capable PSCs can do CT/CTA in less than 15 mins
• If same pool of stroke MDs for PSCs/CSCs, efficient decision making, ready neuro IR team on arrival

https://journals.heart.org/bloggingstroke/2019/02/13/isc-session-one-size-fits-all-models-for-thrombectomy-systems-of-care/
Door in Door out time: Interhospital transfer

• 130 patients transfer from PSC to CSC
• 241 mins for onset to recanalization:
  * 85 mins for PSC DIDO
• 26 mins for interfacility transport
• 21 mins for CSC door to arterial puncture
• 24 mins for puncture to recanalization

**Conclusions**—For patients diagnosed with ELVO at a PSC who are being transferred to a CSC for thrombectomy, longer DIDO times may have a deleterious effect on outcomes and may represent the single biggest modifiable factor in onset to recanalization time. PSCs should make efforts to decrease DIDO and routine use of DIDO as a performance measure is encouraged. *(Stroke. 2018;49:2969-2974. DOI: 10.1161/STROKEAHA.118.021936.)*
New frontier for thrombolysis- extended window?

Extend trial

- IV tPA vs placebo
- Up to 9 hours based on perfusion study
- 65% wake-up stroke
  - 25% between 6-9 hrs
  - 10% between 4.5-6 hrs
- No thrombectomy
- Good outcome 51% in tPA group vs. 43% in placebo
- More in tPA group with early neurological improvement
- No difference in sICH rate

Presented at ISC 2019

MR guided thrombolysis in stroke with unknown time of onset

- 503 patients,
- IV TPA vs placebo based on MRI
- Good outcome in 53% in tPA vs 41% in placebo
- 4.1% death in tPA and 1.2% in placebo
- 2% sICH in tPA vs. 0.4% in placebo

New frontier for thrombolysis – Tenecteplase?

- More fibrin-specific
- Longer half-life
- More resistance inactivation by tissue plasminogen activator inhibitor (PAI-I)
- Ease of administration – bolus over 5 second- only one dose

New trial- TIMELESS
- Tenectaplase vs. placebo in 4.5-24 hours plus thrombectomy in patients with ICA/M1/M2 occlusion with perfusion mismatch on CT scan or MRI
- PPMC/PSVMC participating
Team approach - care coordination between multisystems

PSST EMS
Portland Standardized Stroke feedback Tool for EMS

Patient Presentation:
- Crew Names: Jennifer Nyberg, Daniel Cummings
- Date: 12/15/18
- Case #: 292740
- Fire #: TVF&R

Key Achievements:
- EMS Activates Stroke: Yes
- CSTAT Communicated: Yes
- CSTAT: Positive
- Scene Time: 7 min
- Door to Needle: 45 min
- Door to Groin: 90 min

Outcomes:
- Large vessel occlusion on CTA: Yes
- Initial NIHSS: 18
- Post treatment NIHSS: 0
- Diagnosis: Ischemic Stroke

Comments:
Amazing! Nice work on short scene time and fast transport to definitive care!

That is not part of the medical record. Information within this document is privileged & confidential under ORS 418.775 relating to quality assurance and/or staff physicians.
Thank you
Providence Stroke Center, Providence Telestroke Network
St. Vincent
Portland Medical Center
Willamette Falls
Milwaukie
Hood River
Newberg
Seaside
Medford