Fast and Furious: Hyperacute Ischemic Stroke Care

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Disclosure Statement

• Bader
  • Board of Directors: President
    • Neurocritical Care Society
  • Honorarium
    • Bard
  • Medical Advisory Board
    • Neuroptics and Ceribell
• Stock/ options
  • Neuoptics and Ceribell
Objectives

• Identify the major recommendations from the AHA/ASA 2019 Ischemic Stroke Guidelines
• Develop a hospital based guideline to direct the team on priorities in managing acute ischemic stroke
• Apply key interventions to optimize patient outcomes in the ischemic stroke patient population

What is a stroke?

• Sudden development of a focal neurologic deficit caused by blockage in an artery feeding the brain or a rupture of the artery in the brain
Ischemic Stroke

- 87%
  - Thrombotic/atherosclerotic disease
    - 20%
  - Embolic
    - 20%
  - Lacunar or subcortical stroke
    - 20-25%
    - Small vessel disease
  - Cryptogenic: cause unknown
    - 30%

Case

- 59 year old female is talking on the phone with her friend when she develops speaking difficulty
  - Friend calls 911 and gives address to EMS system

- EMS arrives
  - Patient is unable to move right arm and leg, no sensation to right side and has a droopy mouth on the right
  - Unable to speak
Stroke Chain of Survival

- Detection: Patient or bystander recognizes stroke S/S
- Dispatch: 911 and EMS dispatch
- Delivery: Triage & Tx to Primary Stroke Center
- Door: Immediate triage to acute area
- Data: Prompt ED evaluation, stroke team activation, lab and brain imaging
- Decision: Diagnosis and determination of Tx
- Drug: Administer drugs as indicated (tPA)
- Disposition: Timely admission to stroke unit or ICU or Transfer to stroke center

Numerous Guidelines AIS 2009-2018

Table 2. Guidelines, Policies, and Statements Relevant to the Management of AIS

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Publication Year</th>
<th>Abbreviation Used in This Document</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Recommendations for the Implementation of Telemedicine Within Stroke Systems of Care: A Policy Statement From the American Heart Association</em></td>
<td>2009</td>
<td>N/A</td>
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<td><em>Interactions Within Stroke Systems of Care: A Policy Statement From the American Heart Association/American Stroke Association</em></td>
<td>2013</td>
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<td><em>2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society</em></td>
<td>2014</td>
<td>N/A</td>
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<td><em>Recommendations for the Management of Cardiac and Cerebral Interaction With Seizures: A Statement for Healthcare Professionals From the American Heart Association/American Stroke Association</em></td>
<td>2014</td>
<td>2014 Cardiac Epilepsy</td>
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<td><em>Palliative Care and End-of-Life Care in Stroke: A Statement for Healthcare Professionals From the American Heart Association/American Stroke Association</em></td>
<td>2014</td>
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<td><em>Clinical Practice Recommendations for Adults Hospitalized With Acute Ischemic Stroke: Performance Measures for Healthcare Professionals From the American Heart Association/American Stroke Association</em></td>
<td>2014</td>
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<tr>
<td><em>Part 15: First Aid: 2015 American Heart Association and American Red Cross Guidelines Update for First Aid</em></td>
<td>2015</td>
<td>2015-CPR-First Aid</td>
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<td><em>Scientific Rationale for the Inclusion and Exclusion Criteria for Intravenous Alteplase in Acute Ischemic Stroke: A Statement for Healthcare Professionals From the American Heart Association/American Stroke Association</em></td>
<td>2015</td>
<td>2015IV Alteplase</td>
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ACC indicates American College of Cardiology; AHA, American Heart Association; AIS, acute ischemic stroke; CRI, cardiorespiratory resuscitation; ECG, emergency cardiovascular care; HRS, Heart Rhythm Society; IV, intravenous; and N/A, not applicable.
TOPIC OF INTEREST
ISCHEMIC STROKE

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

William J. Powers, MD, FAHA, Chair; Alejandro A. Rabinshtein, MD, FAHA, Vice Chair;
Teri Ackerson, BSN, RN; Opeolu M. Adeoye, MD, MS, FAHA;
Nicholas C. Bambakidis, MD, FAHA; Kyra Becker, MD, FAHA; Jose Biller, MD, FAHA;
Michael Brown, MD, MSc; Bart M. Demaerschalk, MD, MSc, FAHA; Brian Hoh, MD, FAHA;
Edward C. Januch, MD, MS, FAHA; Chelsea S. Kidwell, MD, FAHA;
Thabele M. Leslie-Murwi, MD; Bruce Orbiagierte, MD, MSc, MAS, MBA, FAHA;
Phillip A. Scott, MD, MBA, FAHA; Kevin N. Sheth, MD, FAHA;
Andrew M. Sonthelander, MD, MSc; Deborah V. Summers, MSN, RN, FAHA;
David L. Tirschwell, MD, MSc, FAHA; on behalf of the American Heart Association Stroke Council

(Stroke. 2018;49:e46-e99. DOI: 10.1161/STR.0000000000000158.)

A bit of controversy...

• AIS originally published January 24, 2018
• Published in print in March 2018
• Retractions done by AHA/ASA in April of 2018

Correction to: 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

Based on recent feedback received from the clinical stroke community related to the article by Powers et al., “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,” which published ahead of print January 24, 2018, and appeared in the March 2018 issue of the journal (Stroke. 2018;49:e46-e110. DOI: 10.1161/STR.0000000000000158), the American Heart Association/American Stroke Association has reviewed the guideline and is preparing clarifications, modifications, and/or updates to several sections in it. Currently, those sections, listed here, have been deleted from the guideline while this clarifying work is in process:

Section 1.3 EMS Systems Recommendation 4
Section 1.4 Hospital Stroke Capabilities Recommendation 1
Section 1.6 Telemedicine Recommendation 3
Section 2.2 Brain Imaging Recommendation 11
Section 3.2 Blood Pressure Recommendation 3
Section 4.3 Blood Pressure Recommendation 2
Section 4.6 Dysphagia Recommendation 1
Section 6.0 All subsections (11)
2019 Updated Guidelines

Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke

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

Endorsed by the Society for Academic Emergency Medicine and The Neurocritical Care Society

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

DOI: 10.1161/STR.00000000000000211
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<tr>
<th>Level A</th>
<th>Single High Quality RCT, or High Quality Meta-analysis, or Multiple RCTs corroborated by Registry Data</th>
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<td>Level B – R</td>
<td>Moderate quality from 1 or more RCT or meta-analysis or moderate quality RCT</td>
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<td>Level B – NR</td>
<td>Moderate quality from 1 or more non-randomized or observational or Registry studies or meta-analysis of these studies</td>
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<tr>
<td>Level C – LD</td>
<td>Randomized &amp; non-randomized observational studies or registry with limitations in design or execution. Meta-analyses of these studies. Physiological or mechanistic studies</td>
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Ischemic Stroke Guidelines

- **Major sections**
  - Prehospital Stroke Management and Systems of Care
  - Emergency Evaluation and Treatment
  - General Supportive Care and Emergency Treatment
  - In Hospital Management of AIS: General Supportive Care
  - In Hospital Management of AIS: Treatment of Acute Complications

- Integrate into lecture only topics pertinent to nursing practice
- Approach the patient as they move through the system
Prehospital Stroke Management and Systems of Care = 32 Recommendations

- **Prehospital/EMS Recommendations (10)**
  - Public education programs emphasizing calling 911
  - Dispatchers should make stroke a top priority and transport times minimized
  - Educational stroke programs for physicians, hospital personnel and EMS are recommended
  - Use of a stroke assessment system by providers is recommended
  - EMS personnel should notify receiving hospital prior to arrival
  - EMS leaders should develop triage paradigms and protocols using validated and standardized instrument for stroke screening (FAST, LA, Cincinnati PHS)
  - Regional systems of stroke care should be developed
  - Patients with positive stroke screen should be transported to closest facility capable of giving IV alteplase.

### Ischemic Stroke

- **Screening Tools**
  - **Prehospital General Stroke**
    - Cincinnati Prehospital Stroke Scale (CPSS)
    - LA Prehospital Stroke Scale (LAPSS)

#### LAPSS

<table>
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<th>Condition</th>
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<td>Age &gt; 45</td>
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<tr>
<td>History of stroke or epilepsy</td>
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<tr>
<td>Duration of symptoms is less than 24 hours</td>
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<tr>
<td>Patient is not wheelchair bound</td>
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<td>Loss of balance or coordination</td>
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<td>Blood glucose level between 160 and 400 mg/dL</td>
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**Physical exam to determine unilateral asymmetry**

- A. Have patient look up, smile and show teeth
  - Equal
  - Right weakness
  - Left weakness

- B. Compare grip strength of upper extremities
  - Weak grip
  - No grip
  - Normal grip

### Cincinnati Pre-hospital Stroke Scale

1. **FACIAL DRAG** Have the patient show both sides of face for 10 sec.
   - Symmetrical
   - Asymmetrical

2. **ARM DRIFT** Have the patient raise both arms out for 10 sec.
   - Symmetrical
   - Asymmetrical

3. **ABNORMAL SPEECH** Have the patient say "cows can’t bend an old dog’s nose to kiss."
   - Crows say "cow's nose to kiss."
   - Normal: Patient says the wrong words, or is unable to speak.

**INTERPRETATION:** If any 1 of these 3 signs is abnormal, the probability of a stroke is 72%

[Sources: emsworld.com, static1.squarespace.com, ems2006.org]
Examples of LVO Tools

**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?”

- 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.

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**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 $= 2$

- 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 $\geq 4$.

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**Prehospital Stroke Management and Systems of Care = 32 Recommendations**

- **Hospital Stroke Capabilities/Teams (6)**
  - Certification of stroke centers by an external body is recommended
  - Organized protocol for emergent evaluation of patient
  - Establish DTN (alteplase) goals: Within 60 minutes $>50\%$ time
  - Establish Secondary DTN (alteplase) goal: Within 45 minutes in $>50\%$ time
  - Designate a multidisciplinary stroke team (include neuro evaluation)
  - Multicomponent Quality Improvement Initiatives

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Nursing Protocol

**DTN < FAST is best (<45 min)**

**MD Team & QI**
Prehospital Stroke Management and Systems of Care = 32 Recommendations

• Telemedicine/Telestroke (7)
  - US FDA Telestroke for timely review of imaging
  - Telestroke evaluation is effective
  - IV tPA by Telestroke is safe
  - Telephone consultation to community MDS is safe
  - Telestroke networks triage AIS for possible transfer to thrombectomy centers

Prehospital Stroke Management and Systems of Care = 32 Recommendations

• Organizational & Integration of Components (5)
  - PSC gives tPA- then evaluates for thrombectomy
  - Mechanical Thrombectomy done at CSC
  - Centers should develop, adopt & adhere to care protocols that reflect current care guideline
  - Establish hand off and transfer protocols and procedures for safe efficient transfer for thrombectomy patients
  - Government develop and implement reimbursement schedules for patients with AIS

• Establishment of Data Repositories (1)
  - Participate in a stroke registry

Telestroke provides fast review of imaging and helps guide tPA in centers without neurology

Care Protocols a must for PSC/CSC
- PSC: Give tPA
- CSC: Thrombectomy

Participate in Data Stroke Registry
Prehospital Stroke Management and Systems of Care = 32 Recommendations

- Stroke Systems Care QI Process (3)
  - Organize a MD QI committee to review and monitor stroke quality benchmarks etc
  - Continuous QI processes can improve patient outcomes
  - Stroke outcome measures should include adjustments for baseline severity

Need a Stroke Quality Improvement Program

Emergency Evaluation and Treatment = 20 Recommendations

- Stroke Scale (1): Use one - (NIHSS)
- Head/Neck Imaging (15)
  - Do it fast (NCCT) within 20 minutes
  - Hypodensities (3 statements)
  - Do not do an MRI (delays tPA)
  - Awoke with stroke: imaging to give tPA still investigational
  - CT/MRI Perfusion should not delay tPA
  - Thrombectomy candidates: CT or MRI Perfusion may help in windows 6-24 hrs
- Other Diagnostic Tests (4)
  - Only BG needed prior to tPA
  - ECG and troponin should not delay tPA
  - Chest x-ray value unclear

CT within 20 min
Do not delay tPA
CT/MR Perfusion if 6-24 hours
Blood Glucose
General Supportive Care & Emergency Tx = 80 Recommendations

- **Airway, Breathing, Oxygenation (4)**
  - Monitor airway/oxygenation
  - O2 only if SpO2 < 94%
  - Hyperbaric is not recommended

- **Circulation (4)**
  - Correct hypotension/hypovolemia
  - Correct BP (IV tPA < 185/110)
  - Drug induced hypertension unclear

- **Temperature (2)**
  - Treat T > 38°C // Do not use hypothermia

- **Blood Glucose (2)**
  - Tx elevated BG (Target 140 - 180 mg/dL)
  - Treat hypoglycemia (< 60 mg/dL)

- **IV Alteplase (23)**
  - Give IV tPA if indicated < 3h or 3-4.5 h
  - 0.9 mg/kg 10% bolus 90% drip over 1 hour
  - Indications
    - Measurable deficit
    - Age ≥ 18
    - Even mild symptoms
      - Treat mild 0-3 hours (3-4.5 for mild disabling not non-disabling)
    - MCA sign not a contraindication
  - Exclusions listed
    - Sickle cell is not a contraindication
    - Hypoglycemia can mimic stroke
    - Discuss Pros/cons
    - Do not wait for INR if they aren’t on drug
    - Time benefit: Faster Better
    - Control BP < 180/105
    - Be prepared to treat potential emergent adverse effects:
      - Monitor for bleeding/angioedema
    - Do not give IV ASA within 90 minutes after the start of alteplase
General Supportive Care & Emergency Tx = 80 Recommendations

• Other IV Thrombolytics and Sonothrombolysis (4)
  – Benefit of defibrinogenating agents or IV fibrinolytic agents other than alteplase or tenecteplase is unproven
  – Tenecteplase administered as a 0.4mg/kg single IV bolus has not been proven superior to noninferior to alteplase but might be considered as an alternative to alteplase in patients with minor neuro impairment and no major intracranial occlusion
  – Sonothrombolysis with IV tPA not recommended

Tenecteplase is new to the scene

• Mechanical Thrombectomy (22)
  – Give tPA if indicated
  – Go directly to thrombectomy if indicated
  – Stent Retrievers for less than 6 hours
  – Thrombectomy recommended in patients
    • LKN with LVO 6-16 hours (DEFUSE 3 Trial)
    • LKN wit LVO 16-25 hours (DAWN Trial)
    • Faster is better
  – Consider usefulness of Anesthesia
  – Keep BP < 180/105 for 24 hours

Give tPA if indicated

Thrombectomy indications have changed 24 h window

Faster is better

• Other EVTs (2)
  – Intraarterial thrombolysis in < 6 hours if indicated

Keep BP < 180/105
General Supportive Care & Emergency Tx = 80 Recommendations

- Antiplatelet Treatment (6)
  - ASA within 24-48 hours (delay 24 if tPA)
  - ASA with clopidogrel in minor stroke patients within 24 hours may be beneficial for early secondary stroke prevention
- Anticoagulants (5)
  - Do not use early anticoagulation to reduce stroke impact
  - Not enough evidence to use DTI/Xa inhibitors in the treatment of AIS
- Volume Expansion (4) – DON’T
- Neuroprotective Agents (1) – None
- Emergency CEA/Angioplasty (2) – Don’t
- Other (1) – Do not use near infrared laser

In-Hospital Management of AIS: Supportive Care = 39 Recommendations

- Stroke Units (2): Unit/Order Sets Good!
- Head Positioning (1) – Flat is Uncertain
- Supplemental O2 (3): Same as before
- BP (4)
  - Lowering BP co-morbid conditions (aortic dissection) by 15%
  - Tx BP > 220/120 if not tPA 1st 48-72 hours
  - Use labetalol, Nicardipine, Clevdipine, Hydralazine, enalapril
  - Get BP down 140/90 by discharge
  - Avoid hypotension/hypovolemia
- Temperature (2): Same
- Glucose (2): Same
In-Hospital Management of AIS: Supportive Care = 39 Recommendations

- Dysphagia Screening (5)
  - Screen pt before fluids/foods/meds
  - SLP should screen for dysphagia
  - An instrumental evaluation is reasonable for patients suspected of aspirating
  - Oral hygiene protocol to reduce pneumonia

- Nutrition (3)
  - Enteral start within 7 days
  - If dysphagia, start NG – then Perc G tube
  - Nutritional supplements are good
  - Good oral hygiene

- DVT (4)
  - Immobile: IPC good + hydration + aspirin
    - Benefit of UFH/LMWH not well established
    - Nor is the prophylactic-dose “ ”
  - Do not use stockings

• Depression Screening (2)
  - Administer structured screen
  - Tx with antidepressants if present

• Other (5)
  - No prophylactic antibiotics
  - Do not routinely place foley catheters
  - Assess skin (Bradens)
  - Eliminate skin friction/moisture: Turn, Skin Care, special mattress
  - Provide Palliative Care resources

• Rehabilitation (6)
  - Early rehab is good / base it on pt needs
  - High dose, rehab within 24 hours should not be done
  - Formal functional assessment of ADLs/functional mobility done by an expert rehab therapist
  - Use of fluoxetine to enhance motor recovery not well established

Screen for Depression
No AB/Foley
Assess/Maintain Skin
Palliative Care Resources
Rehab is good...just not to early
In-Hospital Management of AIS: Treatment of Acute Complications = 14 Recommendations

- Cerebellar/Cerebral Edema (12)
  - Ventriculostomy (ICP) for obstructive hydro
  - May need decompressive sub-occipital craniectomy
  - Malignant edema: talk to family options
    - Should be managed in Neuro ICU/tertiary
  - Craniectomy for Unilateral MCA infarcts <60y
    - Can try in patients > 60y to reduce mortality but...
    - Trigger: decreasing LOC
  - Use Osmotic Meds for CE
  - Use brief period of PaCO2 30-34 mm Hg for CE
  - Hypothermia/Barbs not recommended
  - Do not use steroids

Cerebellar Edema Use ICP/Craniectomy
Talk to Family about outcome if Malignant CE
Use Osmotics/PaCO2 30-34 mm Hg for CE
Do not use Barbs/Steroids/Hypothermia

- Seizures (2)
  - Recurrent seizures after stroke should be treated with anti-seizure drugs
  - Prophylactic use of anti-seizure drugs is not recommended

Treat Seizure if occurs
No Prophylactic Anti-convulsants
In-Hospital Institution of Secondary Stroke Prevention = 59 Recommendations

- Brain Imaging (3)
  - Prevent recurrent stroke – MRI is reasonable

- Vascular Imaging (4)
  - Nondisabling mRS 0-2 AIS in carotid who are candidates for CEA/stenting
  - Imaging is reasonable

- Cardiac Evaluation (5)
  - ECG monitoring for 24 hours at least
  - Echo is reasonable to eval for recurrent stroke

- Glucose (1) – screen for diabetes

- Other tests (4)
  - Screen for sleep apnea
  - No routine antiphospholipid antibodies/ hyperhomocysteinemia

- Antithrombotic Treatment (6)
  - Noncardioembolic AIS - use AP rather than AC
  - Secondary prevention, individualize selection of AP (numerous recommendations on agents)
  - Anticoagulation might be considered when abnormal findings on coag after AIS

Imaging for 2nd Stroke Prevention
ECG for at least 24h
Screen for Diabetes & Sleep Apnea
Institute Antithrombotic Treatment

- Atrial Fibrillation (2)
  - Start oral AC 4-14 days onset of symptoms
  - AF+CAD- uncertain adding AP to oral AC

- Arterial dissection (2)
  - Tx with AP/AC 3-6 months
  - Stenting not well established

- Hemorrhagic Transformation (1)- consider AP/AC

- Carotid Revascularization (1) 48H-7D if nondisabling stroke

- Hyperlipidemia (3)
  - Manage according to 2018 ACC/AHA cholesterol guidelines

- Choice of Lipid-lowering Drugs Clinical ASCVD (10)

- Implementation (4): Assess/reassess statins

Start AC for Afib
Considerations for special circumstances
Lots of Lipid Medications
In-Hospital Institution of Secondary Stroke Prevention = 59 Recommendations

- Timing (2): Initiate in hospital
- Special Patient Groups (4) Recommendations for women
  - Childbearing Age: counsel on reliable form of contraception and stop drugs 1-2 months before pregnancy
  - Advanced Kidney Disease with dialysis: continue statin if on but do not initiate if not on
- Institution of Antihypertensive Meds (1)
  - Start or restart AH Tx during hospitalization in pts with BP > 140/90 in neuro stable
- Smoking Cessation (5)
  - Educate and ALL STAFF ENCOURAGE TO QUIT
  - Consider nicotine patch while in hospital
  - Avoid second hand smoke
  - Use varenicline to promote smoking cessation
- Stroke Education (1)
  - Provide information on impact stroke on their lives

Lots on Lipid Lowering Medications
Special Groups
Women & Dialysis
Smoking Cessation:
ALL STAFF ENCOURAGE PT TO QUIT
STROKE EDUCATION

2019- 2020
TARGET STROKE
2019-2020 Target Stroke Update

NATIONAL GOALS FOR PHASE III

PRIMARY GOALS

• Achieve door-to-needle times within 60 minutes in 85 percent or more of acute ischemic stroke patients treated with IV thrombolytics.

• Achieve door-to-device times (arrival to first pass of thrombectomy device) in 50% or more of eligible acute ischemic stroke patients within 90 minutes (for direct arriving patients) and within 60 minutes (for transfer patients) treated with endovascular therapy (EVT).

SECONDARY GOALS

• Achieve door-to-needle times within 45 minutes in 75 percent or more of acute ischemic stroke patients treated with IV thrombolytics.

• Achieve door-to-needle times within 30 minutes in 50 percent or more of acute ischemic stroke patients treated with IV thrombolytics.

strokeassociation.org/targetstroke
Real World Application of Stroke Guidelines

Initial Recognition/Triage

• Prehospital
  – Activation of EMS via 911 (Prehospital 1.1)
    • EMS delivery of patient contributes to shorter times for stroke care delivery
  – Community Education on Stroke (Prehospital 1.1)
    • Stroke recognition on signs/symptoms of stroke vital to beginning the stroke chain of survival
      – Delay in recognizing stroke s/s is the leading cause of delay in treatment in acute stroke patients
    • Focus on 911 EMS activation key to improving access by public
EMS Recommendations 2019

1. EMS Assessment and Management

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The use of a stroke assessment tool by first aid providers, including EMS dispatch personnel, is recommended.</td>
<td>I</td>
<td>B-NR</td>
</tr>
</tbody>
</table>

1.3. EMS Systems

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Regional systems of stroke care should be developed. These should consist of the following: (a) healthcare facilities that provide initial emergency care, including administration of IV alteplase, and (b) centers capable of performing endovascular stroke treatment with comprehensive periprocedural care to which rapid transport can be arranged when appropriate.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols to ensure that patients with a known or suspected stroke are rapidly identified and assessed by use of a validated and standardized tool for stroke screening.</td>
<td>I</td>
<td>B-NR</td>
</tr>
</tbody>
</table>

EMS - Stroke Chain of Survival

- Detection: Patient or bystander recognizes stroke S/S
- Dispatch: 911 and EMS dispatch
- Delivery: Triage & Tx to a center able to administer IV alteplase (1.3.3 and 1.3.5)
- Door: Immediate triage to acute area
- Data: Prompt ED evaluation, stroke team activation, lab and brain imaging
- Decision: Diagnosis and determination of Tx
- Drug: Administer drugs as indicated (tPA)
- Disposition: Timely admission to stroke unit or ICU or Transfer to stroke center

DOI: 10.1161/STR.0b013e318284056a

4 Stroke March 2013
Initial Triage: Prehospital

• Prehospital: Assessment and Management
  – Rapid evaluation
    • Time of symptom onset is key!
    • Check Blood Glucose and treat if hypoglycemia present
  – Early Stabilization
    • Support CV system: Assess VS/ECG
    • Provide Oxygen if needed
      – Keep SaO2 > 94%
      – If no pulse oximeter available, apply 2-3 L/NC

Initial Triage: Prehospital

• Management Priorities
  – Establish IV access
  – Administration of isotonic fluid, *Normal Saline
  – Head of bed flat if hypotensive
  – Treat SBP > 220mmHg*
  – Keep NPO
  – Draw blood for labs*

*Dependent on local EMS systems and protocols
Initial Triage: Prehospital

- Prehospital Assessment and Management (1.2.1)
  - Neurologic Evaluation

Cincinnati Pre-Hospital Stroke Scale

If any 1 of these 3 signs is abnormal, the probability of a stroke is 72%

Source: https://www.acls.net/acls-suspected-stroke-algorithm.htm

<table>
<thead>
<tr>
<th>Screening Criteria</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age over 45 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. No prior history of seizure disorder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. New onset of neurologic symptoms in last 24 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Patient was ambulatory at baseline (prior to event)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Blood glucose between 60 and 400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exam: look for obvious

<table>
<thead>
<tr>
<th>Facial smile / grimace:</th>
<th>Normal</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Droop</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grip:</th>
<th>Normal</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak Grip</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arm weakness:</th>
<th>Normal</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drifts Down</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If Yes (or unknown) to all items above, LAPSS screening criteria met. If LAPSS criteria for stroke met, call receiving hospital with “code stroke.” If not, then return to the appropriate treatment protocol. (Note: the patient may still be experiencing a stroke even if LAPSS criteria are not met.)

Source: http://www.ebmedicine.net/

Initial Triage: Prehospital

- If able to obtain prior history and presence of stroke risk factors
  - Previous stroke
  - Atrial fibrillation
  - Diabetes
  - Hypertension
- Current relevant medications
  - Anticoagulants and anti-platelet medications
- History of surgery or trauma
- Mimics
  - Seizure at onset of event
  - Hypoglycemia

Load and Go...........

Air medical evacuation is reasonable if ground time to stroke hospital is > 1 hour
Initial Triage: Prehospital

- Prehospital: Notification (1.2.2)
  - Alert receiving hospital of incoming stroke patient
    - Allows for mobilization of key resources for care
    - Advance notification increases use of IV tPA

- EMS personnel
  - Should provide stroke education to ensure the proper identification and treatment of stroke patients
  - Should receive feedback from stroke centers on stroke outcomes related to patients managed by prehospital providers

EMS Assessment of LVO

Prehospital LVO scales

Rapid Arterial Occlusion Evaluation (RACE): ≥ 5 significant

OUR PATIENT RACE IS 2+2+2+0+2=8!

EMS Notifies MH of patient prior to transport!
Initial Actions after Arrival in Emergency Department

Hospital Stroke Teams (1.5)
- Organized Protocol
- Designated Stroke Team with multidiscipline and careful clinical assessment
- Multicomponent QI Initiative

---

Entry of Stroke Patient

- Hospitals must have an organized Stroke Intervention Program
  - rapid identification and triage
  - organized stroke response team
  - protocols for emergent work-up
  - nursing protocols for preparing, administering, and monitoring drug therapy
Time is Brain

- 911
  - Door to ED Physician exam: 5 minutes
  - Door to Stroke expertise: 15 minutes
  - Door to CT scan of brain: 15 minutes
  - Door to CT interpretation: 25 minutes
  - Door to drug (tPA): 30 minutes
  - Door to groin (embolectomy): 60 minutes
  - Door to device: 90 minutes

Arrival to the Emergency Department (ED)

- Priorities
  - Rapid evaluation and assessment in ED
    - Delays in recognition is known to increase time to tPA and large vessel occlusions can lead to the loss of 1.9 million neurons per minute!

- ED Triage
  - 5 level Emergency Severity Index: Suspected stroke should be triaged as a level 2 (Equivalent to trauma and/or AMI)
  - Recognize the stroke S/S
  - Obtain the last known time the patient was well
    - Activate stroke team (prior to arrival)
    - Use protocols to guide team’s actions
    - Goal: GET THE tPA IN AS FAST AS POSSIBLE
**Time is Brain**

**PHASE III**

**TARGET: STROKE**

**SUGGESTED TIME INTERVAL GOALS**

**THE 30 MINUTES DTN GOAL TIME INTERVAL GOALS ARE:**

<table>
<thead>
<tr>
<th>ACTION</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door to physician</td>
<td>≤2.5 min</td>
</tr>
<tr>
<td>Door to stroke team</td>
<td>≤5 min</td>
</tr>
<tr>
<td>Door to CT/MRI initiation</td>
<td>≤15 min</td>
</tr>
<tr>
<td>Door to CT/MRI interpretation</td>
<td>≤25 min</td>
</tr>
<tr>
<td>Door to needle time</td>
<td>≤30 min</td>
</tr>
</tbody>
</table>

**THE 90 MINUTES DTD GOAL TIME INTERVAL GOALS ARE:**

<table>
<thead>
<tr>
<th>ACTION</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door to physician</td>
<td>≤5 min</td>
</tr>
<tr>
<td>Door to stroke team</td>
<td>≤10 min</td>
</tr>
<tr>
<td>Door to CT/MRI initiation</td>
<td>≤20 min</td>
</tr>
<tr>
<td>Door to CT/MRI interpretation</td>
<td>≤35 min</td>
</tr>
<tr>
<td>Door to neurointerventional team activation</td>
<td>≤40 min</td>
</tr>
<tr>
<td>Door to needle time</td>
<td>≤45 min</td>
</tr>
<tr>
<td>Door to patient arrival in NI suite</td>
<td>≤60 min</td>
</tr>
<tr>
<td>Door to puncture</td>
<td>≤75 min</td>
</tr>
<tr>
<td>Door to device</td>
<td>≤90 min</td>
</tr>
</tbody>
</table>

**Arrival of Stroke Patient in the ED @1028**

- **Rapid identification and work-up**
  - Key symptoms
  - Time of symptom onset is crucial
  - Triage to acute area: Classify as emergent

- ED MD at Bedside with Stroke Team

- Neurologist on their way

- **Primary & secondary survey**
  - Neurologic assessment with NIHSS = 16
  - RACE 8+
  - Start IV and draw labs
  - Check Blood glucose
  - Monitor: ECG, SpO2, and serial manual BP assessments
EMS ARRIVAL
(Pre activation of CODE STROKE or ACTIVATION ON ARRIVAL)

Goal <5 min

STROKE SWARM: Immediate General Assessment and stabilization

START TIME CLOCK
ABCs / Establish time of onset (LKW)
NIHSS and RACE - Tier 2 Activation (Cortical Signs and/or RACE >4)
IV access if none
TPA Pre-mix criteria
Quick register pt.
VS, Portable Monitor, and Undress Patient
Venipuncture (Glucose, Cardiac/COAG/BMP if able
ED Stroke Orderset

Goal <15 min

NEGATIVE FOR HEMORRHAGE

Goal 20 min

PATIENT TO NON CONTRAST CT SCAN

POSITIVE FOR HEMORRHAGE

Goal 20 min

THROMBOLYTIC CANDIDATE?

Goal 30 min

YES – ADMINISTER ALTEPLASE (TPA)

LVO Positive
- Consult IR/Neurosurgery
- Activate Tier 1
- Proceed to IR Holding for Tier 1/2 only
- IR consult order

Pre-IR tasks (in IR holding room)
- Shave groin, monitor pt. in IR holding
- If other hours turn on IR room/equipment (HCC)
- IR consult order
- RRT / SCU RN Present / ED RN to stay until handoff

Intra-IR procedure tasks (IR procedure room)
- IR team - Members present documented, puncture, first pass, TICI score, Case Start/Stop Time
- IR MO - post procedure note with TICI score

LVO Negative or Non Tier Cases
- Return to ED for PCU or SCU admit
- Stroke Protocol
- MRI TIA/Stroke Orderset
- Consider MRI, EKG, CT if applicable

NO – CONTINUE WITH SCANS

COMPLETE CTA/CTP

Walk In / Inpatient
(711 CODE STROKE ACTIVATION ON ARRIVAL OR BY FLOOR RN)

Goal 20 min

NEGATIVE FOR HEMORRHAGE

Goal <15 min

PATIENT TO NON CONTRAST CT SCAN

POSITIVE FOR HEMORRHAGE

Goal 20 min

START TIME CLOCK
ABCs / Establish time of onset (LKW)
NIHSS and RACE - Tier 2 Activation (Cortical Signs and/or RACE >4)
IV access if none
TPA Pre-mix criteria
Quick register pt.
VS, Portable Monitor, and Undress Patient
Venipuncture (Glucose, Cardiac/COAG/BMP if able
ED Stroke Orderset

55

56
Urgent Diagnostics: CT- NECT 1040

- CT: NECT (non-contrast enhanced CT) and contrast-enhanced CT of brain
  - Early signs of ischemia can be detected on NECT
- Decision for IV tPA in CT while CTA and CT Perfusion continues!

Urgent Diagnostics: CTA/Perfusion

- CT: Contrast-enhanced CT of brain (CTA)
- CT Perfusion/RAPID software
  - Non invasive vessel imaging is recommended if intra-arterial (IA) thrombolysis or mechanical thrombectomy are being considered
  - Advanced imaging should not delay IV tPA if indicated
- Large vessel occlusion – IR team arriving
IV tPA Indications & Tx Windows

- **Indications**
  - Diagnosis of ischemic stroke causing measurable neurologic deficit
  - Onset of symptoms < 3 hours
  - Age ≥18 years of age
  - May be given in 3-4.5 hours after stroke onset except
    - Age > 80, History Diabetes/Stroke, NIHSS > 25, Taking any anticoagulant

Exclusions updated 2015
General exclusions for tPA

- Unknown time of onset
- Acute or history of intracranial hemorrhage
- Subarachnoid hemorrhage
- Active internal bleeding
- Recent (within 3 months) intracranial or intra-spinal surgery or serious head trauma
- GI malignancy or GI bleed within 21 days
- Presence of intracranial conditions that may increase the risk of bleeding (i.e., AVM, Aneurysm, certain neoplasms)

- Coagulopathy
  - (Platelet count <100,000, Currently using anticoagulant with an INR >1.7 or PT >15 seconds, aPTT > 40 s).

- Current severe uncontrolled hypertension (SBP >185 or DBP >110), current use of novel anticoagulants (within 48 hours)

- Use of tPA in patients with prior IS within 3 months may be harmful

- Infective endocarditis
- Aortic arch dissection
- Intra-axial intracranial neoplasm

---

**tPA administration @ 1058**

- **Administration**
  - tPA box @ bedside in CT
- **Clinical pearls**
  - Assessing patient weight
    - Bed scale Required
    - 70 kg
- **0.9mg/kg, maximum dose of 90mg**
  - 10% of total dose administered in IV bolus over 1-2 minutes = 6.3 mg IVP @ 1058
  - Remaining 90% of dose administered over 1 hour = 56.7 mg @1100

- **Provide Post-administration care**
  - VS and neuro status (abbreviated NIHSS) every 15 minutes x 8, every 30 minutes x 6 hours, hourly for 16 hours
  - Treat BP: SBP > 180 mm Hg or DBP > 105 mm Hg
  - Use Labetalol or Nicardipine
  - If change in neurologic status occurs, stop infusion
    - Contact physician
    - Prepare for immediate CT scan
  - No aspirin, heparin or oral anticoagulation for 24 hours post IV tPA

But we are going to IR....
Alteplase Complications

- Monitoring for development of ICH
- Orolingual Angioedema 1-5% of patients treated
  - Generally transient, contralateral to ischemic hemisphere
  - Associated with Angiotensin Converting Enzyme Inhibitor medication use, stroke location
  - Treatment
    - IV ranitidine, diphenhydramine, methylprednisolone

Hemorrhagic Bleed After Alteplase

Suspected ICH: Neuro change
If drug infusing, stop tPA and assess BP. Maintain SBP < 140-160 mm Hg. STAT CT!
Send labs: CBC, TEG with platelet mapping TEG with platelet mapping. Type and Screen/Crossmatch, & Hold Platelets.

ICH - If less than 12 hours after tPA:
1) 10 units of cryoprecipitate
2) Choose 1:
   a) Tranexamic acid 10 mg/kg IV
   b) Aminocaproic acid (Amicar) 4 grams IV 1st hour then 1 g/h for 8 hours
3) Consider: Order/administer (6-8 units) 1-2 Superpack platelets (especially if Platelet count < 100,000)
4) Consider FFP if need
5) Repeat TEG with platelet mapping after reversal agents given
6) Continue to Maintain SBP < 140 mm Hg with IV Nicardipine

If > 12 hours: Evaluate need for reversal based on actual clot dynamics (TEG), Clinical state, and Surgical Plan.
Solitaire™ FR Revascularization Device—
Clot Retrieval


- A mechanical thrombectomy device combining the ability to restore blood flow, administer medical therapy, and retrieve clot in patients experiencing acute ischemic stroke.

- Swift deployment for fast reperfusion.

- Optimal radial force for all clot types.

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 (grip puncture) within 6 hours of symptom onset.

2015 AHA/ASA Guideline Update

- 2013 guidelines updated to include endorsement of endovascular treatment in ischemic stroke
Job 4: Consider Interventional Options
Intraarterial tPA
Mechanical Thrombectomy Devices
Intracranial stents

Time Window Changing….

2. In patients under consideration for mechanical thrombectomy, observation after IV alteplase to assess for clinical response should not be performed.

DAWN Study 2017

- The results of the DAWN trial was presented at the 3rd European Stroke Organization Conference (ESOC) 2017
  - patients arriving after 6 hours from symptom onset for inclusion in the trial by using imaging and clinical scores to identify those with "target mismatch"
  - Results showed a 2-point difference in the 90-day weighted modified Rankin Scale (mRS) score in favor of the thrombectomy group, which translated into a 73% relative reduction of dependency in activities of daily living and a number needed to treat for any lower disability of 2.0
Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct


METHODS

We enrolled patients with occlusion of the intracranial internal carotid artery or proximal middle cerebral artery who had last been known to be well 6 to 24 hours earlier and who had a mismatch between the severity of the clinical deficit and the infarct volume, with mismatch criteria defined according to age (<80 years or ≥80 years). Patients were randomly assigned to thrombectomy plus stat (thrombectomy group) or to standard care alone (the control group). The coprimary

Score on the Modified Rankin Scale

<table>
<thead>
<tr>
<th>Score on the Modified Rankin Scale</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 or 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombectomy (N=107)</td>
<td>9</td>
<td>22</td>
<td>17</td>
<td>13</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Control (N=99)</td>
<td>4</td>
<td>5</td>
<td>16</td>
<td>34</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

Percent of Patients

A Intention-to-Treat Population
Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct

**Table 2. Efficacy Outcomes.**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Thrombectomy Group (N=107)</th>
<th>Control Group (N=99)</th>
<th>Absolute Difference (95% CI)</th>
<th>Adjusted Difference (95% Credible Interval)</th>
<th>Posterior Probability of Superiority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score on utility-weighted modified Rankin scale at 90 days</td>
<td>5.5±3.8</td>
<td>3.4±3.1</td>
<td>2.1 (1.2-3.1)</td>
<td>2.0 (1.1-3.0)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Functional independence at 90 days — no. (%)]</td>
<td>52 (49)</td>
<td>13 (13)</td>
<td>36 (24-47)</td>
<td>33 (21-44)</td>
<td>&gt;0.999</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

Among patients with acute stroke who had last been known to be well 6 to 24 hours earlier and who had a mismatch between clinical deficit and infarct, outcomes for disability at 90 days were better with thrombectomy plus standard care than with standard care alone. (Funded by Stryker Neurovascular; DAWN ClinicalTrials.gov number, NCT02142283.)

**Publication 1-26-2018**

- 38 US centers: Thrombectomy 6-16 hours
- 182 patients (92 endovascular and 90 standard medical therapy only)
  - Mortality 14% ENDO vs 26% tPA
- Endovascular thrombectomy 6-16 hours after last known well

**ORIGINAL ARTICLE**

Thrombectomy for Stroke at 6 to 16 Hours with Selection by Perfusion Imaging

**Publication 1-26-2018**

**Figure 2.** Scores on the Modified Rankin Scale at 90 Days.

In the above figure, the scores on the Modified Rankin Scale are shown for Endovascular Therapy (N=92) and Medical Therapy (N=90) at 90 days. The scale ranges from 0 to 6, with 0 being no symptoms and 6 being death.

**AHA/ASA Guideline**

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

<table>
<thead>
<tr>
<th>3.7. Mechanical Thrombectomy (Continued)</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. 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.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>8. In selected patients with AIS within 16 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.</td>
<td>Ila</td>
<td>B-R</td>
</tr>
</tbody>
</table>
Neurointerventional Clinical Pearls

• Patients eligible for IV tPA should receive IV tPA

• Additional reperfusion strategies may be considered for patients out to 6 hours of symptom onset
  – IA therapy should be considered if large artery occlusion is suspected and patient is not responding to IV tPA
  – IA treatment should be considered at any time in treatment window if IV tPA is contraindicated

• Newer devices may decrease time and number of passes to retrieve clot, decrease complications

• Time is of the essence

Team Interventions in Interventional Suite

• MD/Tech
  – Concentrating on cerebral angiogram, administration of contrast, localizing pathology and preventing accumulation of clot on catheters

• Interventional RN + RRT/ICU RN (if possible)
  – Providing supplies to team
  – Administering sedation/analgesia to patient
  – Assessing BP/Administering BP medications
  – Assessing neuro status and alerting team of improvement or worsening
  – Assessing peripheral perfusion
Neurointerventional Clinical Pearls

• Post-tPA administration monitoring
  – Clock starts over if tPA administered and IR Tx occurred

• Additional monitoring
  – Post-angio care
    • Groin assessment
      – Site
    • Pedal pulse assessment
    • Neuro assessment
    • Vital sign assessment
  – Recovery from anesthesia

Team Interventions in IR Suite @ 1124

• MD/Tech
  – Concentrating on cerebral angiogram, administration of contrast, localizing pathology and preventing accumulation of clot on catheters

• Interventional RN + RRT/ICU RN (if possible)
  – Providing supplies to team
  – Administering sedation/analgesia to patient
  – Assessing BP/Administering BP medications
  – Assessing neuro status and alerting team of improvement or worsening
  – Assessing peripheral perfusion
Our Patient @ 1300

- ICA/MCA opened with complete reperfusion
- CT post Intervention
- Admit to ICU
- Monitor neuro checks/VS
  - every 15 minutes x 2 hours, every 30 minutes x 6 hours then every hour

<table>
<thead>
<tr>
<th>Current Patient Location</th>
<th>Critical Care</th>
<th>Critical Care</th>
<th>Critical Care</th>
<th>Critical Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing of NIHSS Abbreviated Assessment</td>
<td>Post IPA &amp; retrieval</td>
<td>Post IPA &amp; retrieval</td>
<td>Post IPA &amp; retrieval</td>
<td>Post IPA &amp; retrieval</td>
</tr>
<tr>
<td>Level of Consciousness</td>
<td>Alert</td>
<td>Alert</td>
<td>Alert</td>
<td>Alert</td>
</tr>
<tr>
<td>Aged Patient The Month And Half</td>
<td>Answers Both Correctly</td>
<td>Answers Both Correctly</td>
<td>Answers Both Correctly</td>
<td>Answers Both Correctly</td>
</tr>
<tr>
<td>Aged Patient To Open/Closed Eyes And Open/Closed Fists</td>
<td>Performs Both Correctly</td>
<td>Performs Both Correctly</td>
<td>Performs Both Correctly</td>
<td>Performs Both Correctly</td>
</tr>
<tr>
<td>Motor Function Left Arm</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
</tr>
<tr>
<td>Motor Function Right Arm</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
</tr>
<tr>
<td>Motor Function Left Leg</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
</tr>
<tr>
<td>Motor Function Right Leg</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
<td>No Drift</td>
</tr>
<tr>
<td>Sensory</td>
<td>No Sensory Loss</td>
<td>No Sensory Loss</td>
<td>No Sensory Loss</td>
<td>No Sensory Loss</td>
</tr>
<tr>
<td>Broad Language</td>
<td>No Aphasia</td>
<td>No Aphasia</td>
<td>No Aphasia</td>
<td>No Aphasia</td>
</tr>
<tr>
<td>Dysarthria</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Abbreviated Stroke Scale Score</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Monitoring Neuro Status
Post Procedure

NIHSS
Pupil assessment & Cranial Nerves
NIHSS

- Serial assessment to include area of deficit or interest

Non Invasive ICP - Pupillometer

- Pupillary exam is vital to monitor potential increases in ICP

- High inter-examiner variability (up to 39%) and a severe lack of reliability is reported in:
Interrater Reliability of Pupillary Assessments

DaiWai M. Olson¹ · Sonja Stutzman¹ · Ciji Saju¹ · Margaret Wilson¹ · Weidan Zhao¹ · Venkatesh Aiyagari²

Methods  This single-blinded observational study examined interrater reliability of pupil exam findings between two practitioners and between practitioners and a pupillometer.

- 1166 observations – paired subjective pupillary assessment by practitioners compared to automated pupillometer device assessments

Results  From 2329 paired assessments, the interrater reliability between practitioners was only moderate for pupil size (k = 0.54), shape (k = 0.62), and reactivity (k = 0.40). Only 33.3% of pupils scored as non-reactive by practitioners were scored as non-reactive by pupillometry.

- NPi
- MAX/MIN mm
- %CH %
  Constriction % or Percentage Change
- LAT Seconds
- Latency
  Constriction
  Velocity (CV)
- Maximum
  Constriction
  Velocity (MCV)

Normal > 3-5
Abnormal < 3

< =>: browse records

ID: 0 [L]  2000/01/01 10:16:10
NPI: 4.1 [Right]  4.0 [Left]
MAX: 4.56  4.84
MIN: 3.06  3.25
%CH: 33%  33%
LAT: 0.27  0.27
CV: 2.20  2.27
MCV: 3.81  3.42
DV: 0.75  0.62

0.28 L>R
0.19 L>R
Case 1: Importance of serial pupillary assessments

SICU – New Admits with Neuro Diagnoses q 1h

49 yr old female admitted post op following clipping of a cerebral aneurysm. Pupilometer Assessment @2000 shows normal NPI and Cons Velocity

<table>
<thead>
<tr>
<th>Right Eye Pupil Reactivity</th>
<th>4.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Eye Max Aperture</td>
<td>3.04 mm</td>
</tr>
<tr>
<td>Right Eye Min Aperture</td>
<td>2.13 mm</td>
</tr>
<tr>
<td>Right Eye Percent Change</td>
<td>30 %</td>
</tr>
<tr>
<td>Right Eye Constriction Velocity</td>
<td>1.78 mm/sec</td>
</tr>
<tr>
<td>Left Eye Pupil Reactivity</td>
<td>4.7</td>
</tr>
<tr>
<td>Left Eye Max Aperture</td>
<td>2.87 mm</td>
</tr>
<tr>
<td>Left Eye Min Aperture</td>
<td>2.08 mm</td>
</tr>
<tr>
<td>Left Eye Percent Change</td>
<td>28 %</td>
</tr>
<tr>
<td>Left Eye Constriction Velocity</td>
<td>1.91 mm/sec</td>
</tr>
</tbody>
</table>

Careful reassessment by our Night Shift RN reveals the following:
Careful reassessment by our Night Shift RN reveals the following:

The NPI changed 1 hour before the pupil blew! MD was notified 3 times with the pupilometer changes!!! Patient went to CT and OR for emergent craniectomy!

Case #2

- 78 year old female was admitted to Cardiac Telemetry Unit for Atrial fibrillation and CHF
  - 11:35am -36 hours after admit, daughter calls out for help; Patient became unresponsive with eyes looking up
  - BP 174/76 HR 60 irregular RR12
    - 02 sat 98%
    - BG 116
  - Rapid response RN to bedside and calls a Code Stroke
  - 11:38am – MD at Bedside
  - 11:47 - CT non contrast and CTA
SICu Arrival at 1221

- Patient GCS 1-1-1 and NIHSS 23 RACE Score=6 (LVO score)
- Pupilometer Reading

```
<table>
<thead>
<tr>
<th>Eye</th>
<th>Pupil Reactivity</th>
<th>Max Aperture</th>
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</thead>
<tbody>
<tr>
<td>Right</td>
<td>0</td>
<td>3.67 mm</td>
</tr>
<tr>
<td>Left</td>
<td>0</td>
<td>2.46 mm</td>
</tr>
</tbody>
</table>
```

- Breathing pattern changes to irregular – Pt intubated

Neurologist on case

- CT Non-contrast of brain shows no edema
- CTA Cerebral Vasculature shows occlusion of basilar artery
- IV tPa is given/IR called
Anatomy of Case

- Basilar Artery Occlusion

Basilar Artery feeds posterior brain (occipital lobes) brainstem, and cerebellum
Anatomy of Case

Neurointerventional

Occlusion of Basilar Artery and Posterior Cerebral Arteries
Neurointerventional
Occlusion of Basilar Artery and Posterior Cerebral Arteries – Thrombectomy performed with reopening of the Basilar Artery & PCAs

To SICu Post Procedure

• Intubated on a ventilator
• Sedation changed from Propofol (intra-procedure) to Precedex (post procedure)

Pre Procedure: SICU 1221

<table>
<thead>
<tr>
<th>VENTRICULOGRAPHY</th>
<th>Pupilometry</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Eye Pupil Reactivity</td>
<td>0</td>
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<tr>
<td>Right Eye Max Aperture</td>
<td>3.67 mm</td>
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</tr>
<tr>
<td>Right Eye Min Aperture</td>
<td></td>
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</tr>
<tr>
<td>Right Eye Percent Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Eye Constriction Velocity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Eye Pupil Reactivity</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Left Eye Max Aperture</td>
<td>2.46 mm</td>
<td></td>
</tr>
<tr>
<td>Left Eye Min Aperture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Eye Percent Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Eye Constriction Velocity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post Procedure: SICU 1545

<table>
<thead>
<tr>
<th>VENTRICULOGRAPHY</th>
<th>Pupilometry</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Eye Pupil Reactivity</td>
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</tr>
<tr>
<td>Right Eye Max Aperture</td>
<td>3.3 mm</td>
<td></td>
</tr>
<tr>
<td>Right Eye Min Aperture</td>
<td>1.76 mm</td>
<td></td>
</tr>
<tr>
<td>Right Eye Percent Change</td>
<td>3 %</td>
<td></td>
</tr>
<tr>
<td>Right Eye Constriction Velocity</td>
<td>0.2 mm/sec</td>
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<tr>
<td>Left Eye Pupil Reactivity</td>
<td>4.2</td>
<td></td>
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<tr>
<td>Left Eye Max Aperture</td>
<td>1.8 mm</td>
<td></td>
</tr>
<tr>
<td>Left Eye Min Aperture</td>
<td>1.62 mm</td>
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<tr>
<td>Left Eye Percent Change</td>
<td>10 %</td>
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</tr>
<tr>
<td>Left Eye Constriction Velocity</td>
<td>0.55 mm/sec</td>
<td></td>
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</table>
### SICU Post Procedure

- **Change of Shift NIHSS 20**

#### Vital Signs

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>75 bpm (60-100)</th>
<th>Cardiac Monitor</th>
<th>Bundle Branch Block (±)</th>
<th>13 breaths per min (12-20)</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/11/17</td>
<td>19:30</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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#### NIHSS Abbr

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Protocol Post t-PA</td>
<td>3.24 mm</td>
</tr>
<tr>
<td>Not Alert, Obtunded</td>
<td>2.27 mm</td>
</tr>
<tr>
<td>Performs Both Incorr</td>
<td>30%</td>
</tr>
<tr>
<td>No Effort Agst Gravity</td>
<td>2.38 mm/sec</td>
</tr>
<tr>
<td>No Effort Agst Gravity</td>
<td>4.3</td>
</tr>
<tr>
<td>Some Eff Agst Gravity</td>
<td>3.85 mm</td>
</tr>
<tr>
<td>No Effort Agst Gravity</td>
<td>2.69 mm</td>
</tr>
<tr>
<td>No Sensory Loss</td>
<td>30%</td>
</tr>
<tr>
<td>Mute</td>
<td>2.68 mm/sec</td>
</tr>
</tbody>
</table>

#### Pupilometer

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Care</td>
<td>4.6</td>
</tr>
<tr>
<td>Per Protocol Post t-PA</td>
<td>3.07 mm</td>
</tr>
<tr>
<td>Not Alert, Obtunded</td>
<td>2.15 mm</td>
</tr>
<tr>
<td>Performs Both Incorr</td>
<td>30%</td>
</tr>
<tr>
<td>No Effort Agst Gravity</td>
<td>2.37 mm/sec</td>
</tr>
<tr>
<td>No Effort Agst Gravity</td>
<td>4.7</td>
</tr>
<tr>
<td>Some Eff Agst Gravity</td>
<td>3.32 mm</td>
</tr>
<tr>
<td>No Effort Agst Gravity</td>
<td>2.26 mm</td>
</tr>
<tr>
<td>No Sensory Loss</td>
<td>32%</td>
</tr>
<tr>
<td>Mute</td>
<td>2.49 mm/sec</td>
</tr>
</tbody>
</table>

### Next 24 hours

#### Vital Signs

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>108.8 degrees F (97.6-100.4)</th>
<th>Oral</th>
<th>88 bpm (60-100)</th>
<th>Cardiac Monitor</th>
<th>Bundle Branch Block (±)</th>
<th>Multifocal</th>
<th>26 breaths per min (12-20)</th>
<th>100%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
<th>95%</th>
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<th>95%</th>
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<tbody>
<tr>
<td>11/13/17</td>
<td>16:00</td>
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<td>No Effort Agst Gravity</td>
<td>2.37 mm/sec</td>
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<tr>
<td>Some Eff Agst Gravity</td>
<td>4.7</td>
</tr>
<tr>
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<td>32%</td>
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<td>4.7</td>
</tr>
<tr>
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<td>3.32 mm</td>
</tr>
<tr>
<td>No Sensory Loss</td>
<td>2.26 mm</td>
</tr>
<tr>
<td>Mute</td>
<td>32%</td>
</tr>
</tbody>
</table>

2/13/2020
At 1725...

**Vital Signs**
- Heart Rate: 82 bpm (50-100)
- Ventilator: 40%
- Blood Pressure: 105/50 (72 L)
- Automatic Cuff: 105 mm Hg (90-120)
- Semi-Fowlers: 50 mmHg (60-90) L

**NIHSS Abbr**
- Critical Care
- Per Protocol Post t-PA
- Not Alert, Obtunded
- Answers Both Incorr
- Performs Both Incorr
- No Effort Agst Gravity
- No Effort Agst Gravity
- Some Efft Agst Gravity
- No Effort Agst Gravity
- No Sensory Loss
- Mute
- Unable To Test

**Pupilometer**
- Right Eye Pupil Reactivity: 0
- Right Eye Pupil Aperture: 0
- Left Eye Pupil Reactivity: 0
- Left Eye Pupil Aperture: 0
- Left Eye Mir Aperture: 0
- Left Eye Percent Change: 0
- Ventriculostomy Pupilometry Comments: Q

**Pupil is “cat-eye” shape**

Neurologist notified: Orders Stat CT scan of brain no contrast
CT scan shows no infarct...no compression of brainstem indicating herniation...
Nurse is told to go back to SICU: Nurse challenges Neurologist with pupil shape/no reactivity
Neurologist: OK...we will do a CTA
Results: CTA –Reocclusion of Basilar Artery!

Interventions to Manage Post Interventional Tx with or without tPA
Post Infusion Guidelines tPA/Interventional Tx

• Maintain systolic BP < 180 mm Hg or diastolic BP < 105 mm Hg
  – Use labetalol or nicardipine
  – No invasive tubes for 24 hours

• If neuro condition worsens, notify MD, and prepare for stat CT of brain

• Do not give
  – ASA, heparin, warfarin, ticlid, lovenox, plavix, aggrenox, fragmin, or antithrombotic/antiplatelet

• Keep NPO until swallow assessment done

• Check blood glucose levels q 4 hours x 2

Interventions

• Temperature: Goal Normothermia at 37-38C

• DVT prophylaxis (sequential compression) on admission with mobility planned to begin within 24 hours

• Check orthostatic vital signs

• Aggressive pulmonary toilet

• Skin/mobility issues

• Consult PT/OT/ST/Rehab and physiatrist
Safety Measures: Mobilization/Positioning

• Supportive Care
  – Mobility
    • Bedrest
      – Position items on side of bed
        • Left hemisphere place on left side of bed
        • Right hemisphere place on right side of bed
    • Consult PT/OT

Preparing for Discharge and Quality

Diana Tai
Patient DC Education Requirements

- Written Stroke Education materials given to pt/family
- Required Stroke Education topics
  - Activation of EMS
  - Follow-up Post D/C
  - Med Prescribed @ D/C
  - Risk Factors for Stroke
  - Warning S/S Stroke

Preparing for DC/Transfer

- Make a connection with Patient & their Care Partner
  - Involve family in decision making
  - Family and team meetings to discuss progress
  - Encourage care partner to participate in educational and training sessions
  - Conduct a pre-discharge needs assessment of the home before D/C (OT or PT)
  - Caregiver training if aphasic, positioning, handling shoulder care, how to promote independence, and mobility
Preparing for DC/Transfer

• Make a connection with Patient & their Care Partner
  – Provide education for patient's family/Care Partner on stroke pathology, prevention, stroke s/s, actions to take, follow-up appointments, treatment plan, and community resources
  – Liaison with community providers
  – Review individual patient and care partner psychosocial needs and support needs
  – Provide information on discharge plans and post discharge management to primary care MD/community

Outcome

• Discharged home 3 days after admit
• No residual symptoms or signs of stroke
• Completely independent
• NIHSS 0
• Great teamwork
• Share the success
**ADMISSION** –
On 07/19/2018, a 50 y/o female arrive in MVED via EMS presenting with sudden R facial drool and aphasia for an NIH score of 13. CTA showed L ICA terminus occlusion with distal reconstitution of the L MCA. TPA was administered in CT and patient was sent to IR for thrombectomy.

**DISCHARGE** – Once patient was stable for transfer she was transferred to her in-network hospital on 07/21 with an NIHSS of 0 via ACLS transport.

---

### CODE STROKE TEAM

<table>
<thead>
<tr>
<th>Measure</th>
<th>Time</th>
<th>NIHSS</th>
<th>Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt. Arrival</td>
<td>1609</td>
<td></td>
<td></td>
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<tr>
<td>Door to ED MD</td>
<td>1609</td>
<td>00:00</td>
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</tr>
<tr>
<td>Door to Neurology</td>
<td>1625</td>
<td>00:16</td>
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<tr>
<td>Door to ECG Results</td>
<td>1609</td>
<td>00:00</td>
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<tr>
<td>Door to Lab Results</td>
<td>1613</td>
<td>00:04</td>
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<tr>
<td>CT initiated</td>
<td>1625</td>
<td>00:16</td>
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<tr>
<td>Door to CT Results</td>
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<tr>
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<tr>
<td>IR Notification Time</td>
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<td>Door to Groin Puncture</td>
<td>1702</td>
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<td>Groin Puncture to Reperfusion</td>
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<td>00:45</td>
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<td>Door to Reperfusion</td>
<td>1747</td>
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### MISSION HOSPITAL STROKE DASHBOARD – RRT

**Data through Quarter 4 2018 (Oct-Dec)**

#### Door Times - Stat Procedures

- **Door to ED MD**: 4 min
- **Door to Lab Results**: 17 min
- **Door to EKG Results**: 28 min
- **Door to CT Read**: 34 min

#### CSTK Measures

- **CSTK-9: Arrival Time to Skin Puncture**: 102 min

#### Door Times - Interventions

- **Door to Needle (lPA)**: 43 min
- **Door to Groin**: 102 min
- **Groin Puncture to TICI 2B or Greater**: 86 min
- **Door to IR Intervention TICI 2B or Greater**: 188 min

---

**Quality: Sustainability**
Sustainability

References

Ischemic Stroke


Summary
It takes an entire system and hospital to make it work!

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Diana.Tai2@stjoe.org