Updates on Endovascular Therapy

5th Annual Intermountain Stroke Conference
October 16, 2017

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Disclosures

- Local PI – Swift Prime, STRATIS study
- Pulsar – Clinical events committee
- Off label uses of devices and therapies
Objectives

• Appraise the evidence supporting the use of mechanical thrombectomy in acute ischemic stroke in the early (<6 hours) time window.

• Appraise the evidence supporting the use of mechanical thrombectomy in acute ischemic stroke in the late (6-24 hour) time window.

• Contrast Time based selection and Tissue based selection of candidates for Mechanical Thrombectomy.

• Discuss Stroke Systems of Care Development.
Stroke is the No. 5 cause of death in the U.S.

It is the No. 1 cause of disability in the U.S.
## Time is Brain!

<table>
<thead>
<tr>
<th></th>
<th>Neurons Lost</th>
<th>Synapses Lost</th>
<th>Accelerated Aging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Stroke</td>
<td>1.2 billion</td>
<td>8.3 trillion</td>
<td>36 yrs</td>
</tr>
<tr>
<td>Per Hour</td>
<td>120 million</td>
<td>830 billion</td>
<td>3.6 yrs</td>
</tr>
<tr>
<td>Per Minute</td>
<td><strong>1.9 million</strong></td>
<td>14 billion</td>
<td>3.1 weeks</td>
</tr>
<tr>
<td>Per Second</td>
<td>32,000</td>
<td>230 million</td>
<td>8.7 hrs</td>
</tr>
</tbody>
</table>

(Total number of neurons in the average human brain is 130 billion)

*Stroke* 2006;37:263-266
Acute Stroke Treatments Are Effective
2015: Level 1A Evidence Established

• FIVE major prospective, randomized controlled trials have been published comparing mechanical thrombectomy to best medical management:

  – MR CLEAN
  – ESCAPE
  – EXTEND-IA
  – SWIFT PRIME
  – REVASCAT
A Multicenter Randomized Clinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands (MR CLEAN)

- Sites: 16 centers in Netherlands
- Patients: 500
  - 233 randomized to IA thrombectomy
  - 267 randomized to medical management
- Age 18+
- Included mild-severe stroke severity
- Time: Treatment initiated within 6 hrs
- Primary Outcome: mRS at 90 days
- Treatment in IA arm: No requirement, but retrievable stent in majority

Berkhemer et al; NEJM, 2015
A Multicenter Randomized Clinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands (MR CLEAN)

Good Outcome (mRS 0-2):
33% in IA thrombectomy group
19% in medical group

Conclusion:
Significantly better outcomes with thrombectomy compared to medical management

Berkhemer et al; *NEJM*, 2015
Endovascular Treatment for Small Core and Proximal Occlusion Ischemic Stroke (ESCAPE)

- Sites: 22 centers mostly in N America
- Patients: 315 (halted early due to efficacy)
  - 165 randomized to IA thrombectomy
  - 150 randomized to medical
- Age 18+
- Included mild-severe strokes
- Time: Treatment within 12 hours of onset
- Primary Outcome: mRS at 90 days
- Treatment in IA arm: Retrievable stent

Goyal et al; NEJM, 2015
Endovascular Treatment for Small Core and Proximal Occlusion Ischemic Stroke (ESCAPE)

Good Outcome (mRS 0-2):
- 53% in IA thrombectomy group
- 29% in medical group

Conclusion:
Significantly better outcomes with thrombectomy compared to medical management

Table 2. Primary and Secondary Efficacy Outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention (N = 165)</th>
<th>Control (N = 150)</th>
<th>Difference (95% CI)</th>
<th>Effect Variable</th>
<th>Unadjusted Value (95% CI)</th>
<th>Adjusted Value (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome: modified Rankin score at 90 days;</td>
<td>87/164 (53.0)</td>
<td>43/147 (29.3)</td>
<td>23.8 (13.2–34.4)</td>
<td>Common odds ratio</td>
<td>2.6 (1.7–3.8)</td>
<td>3.1 (2.0–4.7)</td>
</tr>
<tr>
<td>Modified Rankin score of 0–2 at 90 days — no./total no. (%)</td>
<td>87/164 (53.0)</td>
<td>43/147 (29.3)</td>
<td>23.8 (13.2–34.4)</td>
<td>Rate ratio</td>
<td>1.8 (1.4–2.4)</td>
<td>1.7 (1.3–2.2)</td>
</tr>
</tbody>
</table>

Goyal et al; NEJM, 2015
Extending the Time for Thrombolysis in Emergency Neurological Deficits – Intra-Arterial (EXTEND-IA)

- Sites: 10 centers mostly in Australia and New Zealand
- Patients: 70 (halted early due to efficacy)
  - 35 randomized to IA thrombectomy
  - 35 randomized to medical
- Age 18+
- Included mild-severe strokes
- Time: Within 6 hours of onset

Primary Outcomes:
1. Reperfusion at 24 hours (% reduction in perfusion-lesion volume)
2. Decrease in NIHSS of 8 or more points at 3 days, or NIHSS of 0 or 1 at 3 days

Treatment in IA arm: retrievable stent

Campbell et al; *NEJM*, 2015
Extending the Time for Thrombolysis in Emergency Neurological Deficits – Intra-Arterial (EXTEND-IA)

Good Outcome (mRS 0-2):
- 71% in IA thrombectomy group
- 40% in medical group

Conclusion:
Significantly better outcomes with thrombectomy compared to medical management

Campbell et al; *NEJM*, 2015
Solitaire With the Intention For Thrombectomy as PRIMary Endovascular treatment (SWIFT PRIME)

- Sites: 39 centers mostly in US and Europe
- Patients: 196 (halted early due to efficacy)
  - 98 randomized to IA thrombectomy
  - 98 randomized to medical
- Age 18-80
- Included moderate-severe strokes
- Time: Within 6 hours of onset and within 1.5 hours of imaging
- Primary Outcome: mRS at 90 days
- Treatment in IA arm: retrievable stent

Saver et al; NEJM, 2015
Solitaire With the Intention For Thrombectomy as PRIMary Endovascular treatment (SWIFT PRIME)

Good Outcome (mRS 0-2):
60% in IA thrombectomy group
35% in medical group

Conclusion:
Significantly better outcomes with thrombectomy compared to medical management

Saver et al; *NEJM*, 2015
Endovascular Revascularization With Solitaire Device Versus Best Medical Therapy in Anterior Circulation Stroke Within 8 Hours (REVASCAT)

- Sites: 4 centers in Spain
- Patients: 206
  - 103 randomized to IA thrombectomy
  - 103 randomized to medical
- Age 18-85
- Included mild-severe strokes
- Time: Within 8 hours of onset
- Primary Outcome: mRS at 90 days
- Treatment in IA arm: retrievable stent

Jovin et al; *NEJM*, 2015
Endovascular Revascularization With Solitaire Device Versus Best Medical Therapy in Anterior Circulation Stroke Within 8 Hours (REVASCAT)

Good Outcome (mRS 0-2): 44% in IA thrombectomy group 28% in medical group

Table 2. Primary and Secondary Clinical and Imaging Outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Thrombectomy (N=103)</th>
<th>Control (N=103)</th>
<th>Effect Variable</th>
<th>Unadjusted Value (95% CI)</th>
<th>Adjusted Value (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome: score on modified Rankin scale at 90 days</td>
<td>NA</td>
<td>NA</td>
<td>Common odds ratio</td>
<td>1.7 (1.04 to 2.7)</td>
<td>1.7 (1.05 to 2.8)</td>
</tr>
<tr>
<td>Secondary outcome</td>
<td></td>
<td></td>
<td>Odds ratio</td>
<td>2.0 (1.1 to 3.5)</td>
<td>2.1 (1.1 to 4.0)</td>
</tr>
<tr>
<td>Score of 0 to 2 on modified Rankin scale at 90 days — no. (%)</td>
<td>45 (43.7)</td>
<td>29 (28.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Stroke Trials: Outcome

Good Outcome (%)

Control  19%  28%  29%  36%  40%  30%

MT  33%  44%  53%  60%  71%  38%

MR CLEAN  P<0.5  
REVASCAT  P<0.05  
ESCAPE  P<0.001  
SWIFT PRIME  P<0.001  
EXTEND-IA  P<0.01  
THERAPY  NS
New Device Technology is a Game Changer

Stentriever  Large Bore Aspiration Catheters
Stroke Trials: Time to Reperfusion

Patients with substantial (TICI 2b/3 reperfusion had better 90 day outcomes
Patients with more rapid reperfusion had better 90 day outcomes

Prabhakaran et al; JAMA, 2015
HERMES: Pooled Data of Trials

Figure 1: Scores on the modified Rankin Scale at 90 days
Distribution of scores at 90 days in the intervention and control groups in the overall trial population (A) and for patients treated with, or ineligible for, intravenous alteplase (B). Distributions for other subgroups shown in appendix pp 5–11.

Figure 2: Forest plot showing adjusted treatment effect for mRS at 90 days in prespecified subgroups with p values for heterogeneity across subgroups.
COR=common odds ratio. mRS=modified Rankin Scale. ASPECTS=Alberta Stroke Program Early CT score.
ICA=internal carotid artery. M1=M1 segment of middle cerebral artery. M2=M2 segment of middle cerebral artery.
NIHSS=National Institutes of Health Stroke Scale.

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Lancet 2016; 387: 1723–31
Class I: Endovascular Therapy
- Pts **should receive** IAT if they:
  - Have baseline mRS≤1, received tPA, ICA or M1 occlusion, ≥18yo, NIHSS≥6, ASPECTS≥6, start treatment within 6hrs (LOE A, **new**)
- If considering IAT, **vessel imaging** recommended but should not delay IV tPA (LOE A, **new**)

<table>
<thead>
<tr>
<th>new</th>
<th>revised</th>
<th>unchanged</th>
</tr>
</thead>
</table>

AHA/ASA Guidelines
Class II: Endovascular Therapy

- Treatment >6hrs, benefit unclear (IIb, LOE C, new)
- Treatment reasonable but benefit unclear in M2, M3, vertebral, basilar, PCA occlusions (IIb, LOE C, new)
- Treatment reasonable but benefit unclear in those <6hrs, mRS>1, ASPECTS<6, NIHSS<6 with ICA, M1 occlusion (IIb, LOE B-R, new)
- Goal TICI 2b/3 (IIb, LOE B-R, new)
- Treatment reasonable but benefit unclear in <18yo with LVO and tx within 6hrs (IIb, LOE C, new)
How Should This Change Practice

• Stroke team / endovascular team should be notified as soon as patient gets to the hospital or transfer is requested
• All patients should get IV tPA if eligible
• All patients should be considered for endovascular therapy
• Non-Contrast CT head to make initial decisions
• Vessel imaging only if it does not delay IV tPA
• Communicate with endovascular team as soon as possible
Extending the Window for Intra-arterial Stroke Therapy
Case: 45 y.o. with aphasia and right sided weakness

- **History of Present Illness:**
  - Visiting mother, last seen well night before
  - In am, mother found him later lying on bathroom floor unable to get up
  - EMS called, noted to have global aphasia and dense right sided weakness
Case:

- **Past Medical History:** None
- **Past Surgical History:** None
- **Social History:** Ambulates independently
- **Medications:** None
- **Family History:** None
- **Review of Systems:** None
Case:

- **Physical Exam:**
  - Vitals: Temp 36.8°C, HR 90, BP 150/84, RR 20, SpO\textsubscript{2} 95% RA
  - General: no acute distress
  - Lungs: Clear to auscultation bilaterally, good air exchange
  - Heart: regular rhythm, no murmurs
  - Abdomen: soft, obese, non-tender, non-distended, normal bowel sounds
  - Skin: Normal color, texture and turgor. No overt trauma
## Case:

### NIHSS

<table>
<thead>
<tr>
<th>1: Level of Consciousness (LOC)</th>
<th>6: Motor Leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a: LOC Responsiveness</td>
<td>6a: Motor L Leg</td>
</tr>
<tr>
<td>1b: LOC Questions</td>
<td>6b: Motor R Leg</td>
</tr>
<tr>
<td>1c: LOC Commands</td>
<td>7: Limb Ataxia</td>
</tr>
<tr>
<td>2: Horizontal Eye Movement (Best Gaze)</td>
<td>8: Sensory</td>
</tr>
<tr>
<td>3: Visual Field Test</td>
<td>9: Speech (Best Language)</td>
</tr>
<tr>
<td>4: Facial Palsy</td>
<td>10: Dysarthria</td>
</tr>
<tr>
<td>5: Motor Arm</td>
<td>11: Extinction &amp; Inattention</td>
</tr>
<tr>
<td>5a: Motor L Arm</td>
<td></td>
</tr>
<tr>
<td>5b: Motor R Arm</td>
<td></td>
</tr>
</tbody>
</table>

| Total NIHSS: 23 |

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Would you offer intra-arterial stroke therapy?
Need a proper target: Salvageable Brain

• We still do not have consensus on what the best selection approach is

• Time based: Time is most critical factor, thus, should minimize imaging before procedure

• Tissue based: Try to utilized advanced imaging (MRI DWI, MRI or CT Perfusion) to better identify core infarct/penumbral tissue/collaterals
Late-Presenting Strokes:

The DEFUSE 3 and DAWN trials
Extending the Time Window – DAWN and DEFUSE 3

• 2 Trials assessing extending the time window past 6 hours have recently been stopped due to overwhelming efficacy.

• DAWN:
  – 6-24 hours post onset.
  – Imaging selection (RAPID)
  – Significant benefit in primary outcome (mRS 0-2 at 90 days)
  – NNT 2.0!!

• DEFUSE 3:
  – Interim analysis suggested high likelihood of benefit.
  – Results to be presented soon.
DAWN

**DWI or CTP Assessment with Clinical Mismatch**
In the Triage of **Wake-Up** and Late Presenting Strokes 
Undergoing **Neurointervention** with Trevo

To demonstrate superior functional outcomes at 90 days with 
**Trevo plus medical management** compared to medical 
management alone 
in appropriately selected patients treated 
6-24 hours after last seen well

Courtesy of Drs. Jovin and Nogueira
DAWN

NCCT/DWI:
<1/3 MCA Territory

CTA/MRA:
ICA-T and/or MCA-M1
(Tandem Occlusions Allowed)

RAPID CTP/DWI CIM:
A. ≥80 y/o:
   1. NIHSS ≥10 + core <21cc
B. <80 y/o:
   2. NIHSS ≥10 + core <31cc
   3. NIHSS ≥20 + core <51cc

Informed Consent

1:1 Randomization:
- CIM subgroup
- ICA-T vs M1
- 6-12 vs 12-24h

Control

90-day mRS
- U-W mRS
- mRS 0-2

Thrombectomy

Courtesy of Drs. Jovin and Nogueira
DAWN

Primary outcome

TREVO
- mRS 0/uW mRS 10: 9%
- mRS 3/uW mRS 6.5: 22%
- mRS 1/uW mRS 9.1: 17%
- mRS 4/uW mRS 3.3: 13%
- mRS 2/uW mRS 7.6: 13%
- mRS 5-6/uW mRS 0: 26%

Probability of superiority >0.9999

CONTROL
- mRS 0/uW mRS 10: 4%
- mRS 3/uW mRS 6.5: 5%
- mRS 1/uW mRS 9.1: 16%
- mRS 4/uW mRS 3.3: 34%
- mRS 2/uW mRS 7.6: 36%

73% relative risk reduction of dependency in ADL's NNT for any lower disability 2.0
Secondary Endpoints

- Significant benefit
  - Less infarct growth
  - Early response by NIHSS
  - Recanalization rate at 24 hours

- No significant difference
  - No mortality benefit

Full analysis, results and publication pending
Principle Investigators
Dr. Gregory W. Albers, Stanford University
Dr. Michael P. Marks, Stanford University
Funding
NIH StrokeNet
DEFUSE 3

• NIH-funded, prospective, randomized, multi-center, phase III, adaptive, blinded endpoint, controlled trial

• Paradigm shift
  – From clock-based selection to imaging-based selection
  – Target population
    – Patients with anterior circulation ischemic strokes
    – Presenting within 6-16 hours of last known well
    – Imaging evidence of limited ischemic core and large penumbra
### DEFUSE 3

#### Clinical Criteria

<table>
<thead>
<tr>
<th>Key Inclusion Criteria</th>
<th>Imaging Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation consistent with an anterior circulation ischemic stroke</td>
<td>ASPECT Score ≥ 6 on non-contrast CT head</td>
</tr>
<tr>
<td>Age 18-90 years</td>
<td>MR or CT angiography shows an ICA or MCA-M1 occlusion</td>
</tr>
<tr>
<td>Baseline NIHSS ≥ 6</td>
<td>Target mismatch on CTP or PWI (RAPID):</td>
</tr>
<tr>
<td>Pre-stroke mRS 0-2</td>
<td>- Ischemic core &lt; 70mL</td>
</tr>
<tr>
<td>Endovascular treatment feasible within 6-16 hours from LKW</td>
<td>- Mismatch ratio ≥ 1.8 and mismatch volume ≥ 15 mL</td>
</tr>
<tr>
<td></td>
<td>Or DWI lesion &lt;25 mL if obtained within 60 mL of CTA/MRA*</td>
</tr>
</tbody>
</table>

#### Key Exclusion Criteria

| Treatment with tPA > 4.5 h or thrombectomy < 6 h from LKW | Evidence of intracranial tumor, acute intracranial hemorrhage, or AVM           |
| Stroke in multiple locations or suspected bacterial endocarditis | Significant mass effect with midline shift                                       |
| Concurrent other serious illness or life expectancy < 6 months | Evidence of ICA flow-limiting dissection or aortic dissection                   |
| SBP > 185 / DBP > 110 mmHg not treatable with medications | Occlusions in multiple vascular territories                                       |
| Contraindications for contrast, incl. refractory iodine allergy | Intracranial stent implanted in the same vascular territory that would preclude safe deployment / removal of the neurothrombectomy device |
| Participation in another investigational drug/device study/registry |                                                                              |

Only ~50% of patients in DEFUSE 3 are DAWN-eligible
DEFUSE 3 Eligibility
DEFUSE 3

DEFUSE 3 Planned Timetable

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Install RAPID at all sites Begin enrollment <em>(early 2016)</em></td>
</tr>
<tr>
<td>Year 2</td>
<td>Enrollment continues (projected total of 4 years)</td>
</tr>
<tr>
<td>Year 3  (or N=200)</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; interim analysis Potential stop or modification of enrollment criteria based on adaptive design</td>
</tr>
<tr>
<td>Year 4  (or N=340)</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; interim analysis Potential stop or modification of enrollment criteria based on adaptive design</td>
</tr>
<tr>
<td>Year 5</td>
<td>Completion of enrollment, data analysis, and publication of results</td>
</tr>
</tbody>
</table>

- 1<sup>st</sup> subject enrolled in May 2016
- 182<sup>nd</sup> and final patient enrolled in May 2017
  - Pending 90-day follow-up
- Enrollment halted after DAWN results announced

Albers, GW et al. ISC 2016.
DEFUSE 3: Positive Result

On Monday, July 24, 2017:

“The DSMB recommended study enrollment be permanently stopped for all subjects because of the high likelihood of benefit in the endovascular group.”

Results will be presented at the ISC in late January.
IMPLICATIONS OF EXTENDING PATIENT ELIGIBILITY FOR ENDOVASCULAR THERAPY
Extended Time Window

• Current treatment window <6 hours
  – Large-vessel occlusion ≈ 11% of acute strokes

• Trials positive for patients up to 16-24 hours
  – Careful selection is key

• Possible further expansion of eligibility given on-going studies
Resources

• System structure likely needs to change

• Foreseeable challenges
  – EMS training and availability
  – Increase in ED volume
  – Transfer resources to Comprehensive Stroke Centers
  – Imaging volume
    – Operational time, personnel, cost
  – Hyperacute/acute stroke alerts
  – Interventional Team availability
    – Nurses, technicians, physicians
HOSPITAL LEVELS OF CARE

Primary Stroke Center (PSC)
- Stabilize and provide emergency care for patients with acute stroke
- Either admit or transfer to a CSC
- Over 1,000 PSCs to date

Comprehensive Stroke Center (CSC)
- Have the capability to support all needed levels of care to stroke patients, including
  - Special interventions
  - Highly technical procedures
- 74 certified CSCs to date (began 9/2012)

http://www.qualitycheck.org/StrokeCertificationList.aspx
Current Stroke System of Care

CSC Hub

EMS

PSC Spoke

PSC Spoke

PSC Spoke

EMS

EMS

EMS

EMS

EMS

EMS

EMS

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Assessing Time Delays in a System

Sun, Gupta et al. Circulation 2013

Cleveland Clinic

Sun, Gupta et al.  Circulation 2013
Outcomes of Spoke-Retained Telestroke Patients Versus Hub-Treated Patients After Intravenous Thrombolysis

Telestroke Patient Outcomes After Thrombolysis

Danielle L. Heffner, BA; Parthasarathy D. Thirumala, MD, MS; Pooja Pokharna; Yue-Fang Chang, PhD; Lawrence Wechsler, MD

Fig. 1 Effectiveness of the different treatments available for acute phase confidence interval (CI).
Higher volume endovascular stroke centers have faster times to treatment, higher reperfusion rates and higher rates of good clinical outcomes

Rishi Gupta,¹ Anat Horev,² Thanh Nguyen,³ Dheeraj Gandhi,⁴ Dolora Wisco,⁵ Brenda A Glenn,¹ Ashis H Tayal,⁶ Bryan Ludwig,⁷ John B Terry,⁷ Raphael Y Gershon,⁸ Tudor Jovin,² Paul F Clemmons,⁹ Michael R Frankel,¹ Carolyn A Cronin,¹⁰ Aaron M Anderson,¹ Muhammad Shazam Hussain,⁵ Kevin N Sheth,¹⁰ Samir R Belagaje,¹ Melissa Tian,⁶ Raul G Nogueira¹
How should we reorganize our stroke systems of care?

a) Where should EMS bring stroke patients?

b) Severity adjusted triage of patients by EMS

c) Mobile Stroke Units to facilitate early recognition, appropriate triage, and quicker rtPA and IAT treatment
Future Stroke System of Care

CSC Hub

EMS

PSC Spoke

EMS

PSC Spoke

EMS

PSC Spoke

EMS

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Problem with all patients coming to CSCs

- Centralization can quickly overwhelm resources at CSCs
  - Often are large tertiary/quaternary centers which are near capacity already

- Time range for bypass?
  - 15min? 30 min?

- Likely would have to develop multiple CSCs based on population and geography
  - Political issues
Trauma Systems: Saving Lives

"The Golden Hour is critical for injured patients. Getting them to the right place at the right time saves lives."

Injury

Life Threatening Injuries

Emergency Medical Systems (Pre-Hospital)
- Triage
- Stabilization
- Communication
- Transportation

Less Serious Injuries

To Trauma Center

Ready Trauma Team Available 24/7
- Trauma Surgeons
- Trauma Nurses
- Specialty Surgeons
- Anesthesiologists
- Other Specialists and Support

Specialty ICU Treatment
- Trauma Program Manager

To Emergency Room (ER) / Emergency Department (ED)

ER / ED Staff Available On-Call
- Physicians
- Nurses
- Surgeons

Home

Rehabilitation

Hospital Stay
EMS determining severity in the field?

• LA Motor Score
• Cincinnati Pre Hospital Severity Scale
• RACE Score
• And many others……
Cincinnati stroke scale

Interpretation: if any of these 3 signs is abnormal, the probability of a stroke is 72%

**Facial Droop**
*The patient shows teeth or smile*
- Normal – both sides of the face move equally
- Abnormal – one side of the face does not move as well as the other side

**Arm Drift**
*The patient closes eyes and extends both arms straight out, with palms up for 10 seconds*
- Normal – both arms move the same or both arms do not move at all (other findings, such as pronator drift, may be helpful)
- Abnormal – one arm does not move or one arm drifts downward

**Abnormal Speech**
*The patient repeats “you can’t teach an old dog new tricks”*
- Normal – patient uses correct words with no slurring
- Abnormal – patient slurs words, uses the wrong words, or is unable to speak
# Los Angeles Motor Scale

<table>
<thead>
<tr>
<th>Table. The Los Angeles Motor Scale (LAMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial droop</td>
</tr>
<tr>
<td>Absent</td>
</tr>
<tr>
<td>Present</td>
</tr>
<tr>
<td>Arm drift</td>
</tr>
<tr>
<td>Absent</td>
</tr>
<tr>
<td>Drifts down</td>
</tr>
<tr>
<td>Falls rapidly</td>
</tr>
<tr>
<td>Grip strength</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Weak grip</td>
</tr>
<tr>
<td>No grip</td>
</tr>
</tbody>
</table>
85% accuracy with LAMS of 4 or 5 in detecting LVO
Mobile Stroke Treatment Unit: Diagnosis and Emergency Care

- Don’t wait for the patient to go to ER
- Bring the CT and stroke expertise to the patient
- Initiate treatment at the scene
- Dramatically cut time-to-treatment decisions
First MSTU to solely utilize Telemedicine and Teleradiology for care.
Right Place, the first time

In keep with STEMO data (Wendt, Stroke 2015)

- Reduced transfers to non-stroke unit centers
- Reduced ICHs transferred to non-neurosurgical centers

Thus far, no patients have required a second transfer
Conclusions

• We now have Level 1A evidence for use of mechanical thrombectomy for Acute Ischemic stroke, both <6 hours and 6-24 hours post symptom onset.

• Patient with large vessel occlusion type stroke need to come to an interventional capable center as soon as possible

• Due to this, a redesign of stroke systems of care is required
  – Careful planning based on population, geography etc is required.
Questions?