Stroke Update

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Objectives

- To provide a comprehensive approach to acute stroke management.
- To provide guidelines for IV, IA, combined IA-IV rt-PA, and mechanical thrombectomy.
- To provide a review of telestroke.
**Stroke Facts**

- Third leading cause of death
- A stroke occurs every 40 s in the USA
- Every 3.3 min someone dies from stroke
- Leading cause of adult disability
- Over 4 million stroke survivors

**Stroke Subtypes**

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacunar</td>
<td>19%</td>
</tr>
<tr>
<td>Thromboembolic</td>
<td>6%</td>
</tr>
<tr>
<td>Cardioembolic</td>
<td>14%</td>
</tr>
<tr>
<td>Ischemic</td>
<td>71%</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td>26%</td>
</tr>
<tr>
<td>ICH</td>
<td>13%</td>
</tr>
<tr>
<td>SAH</td>
<td>13%</td>
</tr>
<tr>
<td>Unknown</td>
<td>32%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
</tr>
</tbody>
</table>

Stroke Presentation

- Transient Ischemic Attack (TIA)
- Acute Ischemic Stroke
TIA

- Old definition: symptoms lasting <24 hr.
- New definition: Symptoms lasting < 1 hr.
- Majority of TIAs resolve within 60 minutes.
- Most TIA resolve within 30 minutes.

TIA and Stroke as Predictors of Secondary Stroke

<table>
<thead>
<tr>
<th></th>
<th>Post-TIA (%)</th>
<th>Post-Stroke (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 days</td>
<td>4 – 8</td>
<td>3 – 10</td>
</tr>
<tr>
<td>1 year</td>
<td>12 – 13</td>
<td>5 – 14</td>
</tr>
<tr>
<td>5 years</td>
<td>24 – 29</td>
<td>25 – 40</td>
</tr>
</tbody>
</table>

**Short-term Prognosis after ED Diagnosis of TIA**

| Outcome events | Inclusion criteria: TIA by ED physicians  
| 30.0% | Short-term risk of stroke after ED diagnosis  
| 25.0% | Risk of stroke and other events during the 90 days after index TIA  
| 20.0% | Total events: 25.1%  
| 15.0% |  
| 10.0% |  
| 5.0% |  
| 0.0% |  

- **Stroke**  
- **Recurrent TIA**  
- **CV event**  
- **Death**

- 10.5% Within 90 days  
- 5.3% Within 48 hr  
- 12.7%  
- 2.6%  
- 2.6%


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**TIA**

- **Do we need to admit all TIA’s?**
- **What work up is enough to D/C from ER**
### ABCD2 Score

<table>
<thead>
<tr>
<th>Condition</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age older than 60 years</td>
<td>1 point</td>
</tr>
<tr>
<td>SBP $\geq$ 140 mm Hg</td>
<td>1 point</td>
</tr>
<tr>
<td>DBP $\geq$ 90 mm Hg</td>
<td>1 point</td>
</tr>
<tr>
<td>Unilateral weakness</td>
<td>2 points</td>
</tr>
<tr>
<td>Speech impairment without weakness</td>
<td>1 point</td>
</tr>
<tr>
<td>TIA duration $\geq$ 60 min</td>
<td>2 points</td>
</tr>
<tr>
<td>TIA duration 10-59 min</td>
<td>1 point</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1 point</td>
</tr>
</tbody>
</table>


### ABCD2 Risk stratification

<table>
<thead>
<tr>
<th>Score</th>
<th>Stroke Risk 2 days</th>
<th>Stroke Risk 7 days</th>
<th>Stroke Risk 90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq$ 3</td>
<td>1%</td>
<td>1.2%</td>
<td>3.1%</td>
</tr>
<tr>
<td>4-5</td>
<td>4.1%</td>
<td>5.9%</td>
<td>9.8%</td>
</tr>
<tr>
<td>$\geq$ 5</td>
<td>8.1%</td>
<td>11.7%</td>
<td>17.8%</td>
</tr>
</tbody>
</table>

ABCD2 and ED Management

TIA

Score ≤ 3
Workup in ED

Score >3
Admitted

Ischemic Stroke

Acute Stroke Treatment

- IV rt-PA
- IA rt-PA
- Combined IV-IA rt-PA
- Mechanical Embolectomy
Stroke: Every Minute Counts

Early Rx was better in the NINDS tPA Trial

Goal treatment timeline
door-to-needle

- Evaluation by physician: 10 min
- Stroke expertise contacted: 15 min
- Head CT or MRI performed: 25 min
- Interpretation of CT/MRI: 45 min
- Start of treatment: 60 min

Is the Golden Hour Achievable?
# Limitations

- 21% of the US population lives in rural areas
- Significant shortage of physicians with expertise in acute stroke treatment
- Four neurologists per 100,000 persons
- Many neurologists have discontinued hospital privileges

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## rt-PA Experience

- A review of Medicare data for 4750 hospitals showed that only 2.4% of patients are treated with t-PA.
- 60% of hospitals reported no t-PA treatment.
  - Smaller hospitals <100 beds
  - Rural areas

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Hess DC et al. Cerebrovascular Disease and Stroke. 2011, 13:215
Primary Stroke Centers

- More than 600 PSC across the US.
- Most located in metropolitan areas
- <25% of US population lives within 30 min of PSC
- Only half able to reach a PSC within 1 h if state boundaries respected by ground ambulance

Treatment of Stroke in rural area

- Ship and drip
- Drip and ship
Ship and Drip Concept

- Patients initially assessed in rural hospital
- Transfer patients who are able to get to a PSC within 3 h
- This is feasible probably within 80 miles radius
- Not a desirable solution

Drip and Ship Concept

- Initial assessment in rural hospital
- Consultation with stroke expert through phone consultation or telestroke
- t-pa started then patient is transferred
Telestroke
<table>
<thead>
<tr>
<th>IV rt-PA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0-3 h last known well</td>
<td></td>
</tr>
<tr>
<td>• 3-4.5 h last known well</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV rt-PA Eligibility</th>
<th>0-3 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Diagnosis of ischemic stroke</td>
<td></td>
</tr>
<tr>
<td>• Onset of symptoms &lt; 180 min</td>
<td></td>
</tr>
</tbody>
</table>
Updated Contraindications to rt-PA

Clinical

• Symptoms suggestive of intracerebral hemorrhage or subarachnoid hemorrhage
• Persistent blood pressure elevation >185/110
• Active bleeding or acute trauma (fx)
### Historical

- Intracranial or intraspinal surgery or serious head trauma in prior 3 months
- Presence of intracranial conditions that increase risk of bleeding (tumor, vascular malformations, ..)

### Laboratory

- Bleeding diathesis
Other Relative Contraindications

- Seizure at onset of stroke
- Serum glucose <50 mg/dl or >400 mg/dl
- Hemorrhagic eye disorders
- Myocardial infarction in the prior six weeks
- Suspected septic embolism
- Infective endocarditis

Radiological

- Evidence of hemorrhage
- Major early infarct signs
  - Diffuse swelling of affected hemisphere
  - Parenchymal hypodensity
  - Effacement of >33% of middle cerebral artery territory
**NINDS rt-PA Stroke Study**

- Prospective, randomized, double-blind trial
- 624 patients: half treated within 90 minutes, half treated within 91 to 180 minutes
- rt-PA dose: 0.9 mg/kg, maximum dose: 90 mg, 10% as IV bolus, remainder via 1-hour infusion
- Careful attention to Bp: <185/110
- No anticoagulant or antiplatelet agents for 24 hours

**IV rt-PA and Outcome**

Discharge dispositions from initial hospitalization in the NINDS study

<table>
<thead>
<tr>
<th></th>
<th>t-PA (n=312)</th>
<th>Placebo (n=312)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>48%</td>
<td>36%</td>
</tr>
<tr>
<td>Inpatient rehabilitation unit</td>
<td>29%</td>
<td>37%</td>
</tr>
<tr>
<td>Nursing Home</td>
<td>7%</td>
<td>13%</td>
</tr>
<tr>
<td>Other facility</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Dead</td>
<td>11%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Baseline symptoms and outcome


rt-PA Complications

- In a meta-analysis of 15 published studies rate of ICH was 5.2% in 3 month
- Increase rate of hemorrhage was associated with protocol deviations.

3 TO 4 ½ HOURS

- 821 patients
- 18 to 80 years old randomized to tPA vs placebo
  - 52% no disability with tPA vs 45% placebo
  - No mortality difference (7.7% tPA vs 8.4%)
  - Symptomatic hemorrhage 7.9% tPA vs 3.5%

ECASS III: NEJM 2008;359:1317-29

Contraindications to tPA 3 - 4.5 hours

- Patients older than 80 years
- Patients taking oral anticoagulants regardless of INR
- Patients with baseline NIHSS >25
- Patients with history of diabetes and stroke

IV t-PA should be administered to eligible patients who can be treated in the time period of 3 to 4.5 hours after stroke (Class I Recommendation, Level of Evidence B).
Science Advisory from AHA. Stroke 2009,40:2056
Conclusion

• Acute stroke is analogous to trauma:
  – Patients should be quickly assessed and screened for t-PA
  – Stroke expertise should be at the bedside either physically or through telemedicine approach

Stroke Update

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Disclosures

- None

Quick facts

- Ischemic stroke over 700,000 patients annually in the United States
- Leading cause of combined morbidity and mortality in the western hemisphere
- Most common etiologies
  - large-artery atherosclerosis (20–30%)
  - cardiac (20–30%)
  - small-vessel or lacunar stroke (20–30%)
Endovascular thrombectomy

- 5 randomized clinical trials demonstrated that mechanical thrombectomy of large vessel occlusion strokes improved neurological outcomes compared to maximal medical therapy
- Previously, the only class I data to support therapy in acute ischemic stroke was IV rTPA published in 1995 – 20 years ago!

Decompressive hemicraniectomy

- In patients who suffer large middle cerebral artery ischemic stroke, 3 European randomized clinical trials (HAMLET, DECIMAL and DESTINY) demonstrated
  - decreased mortality
  - improved neurological outcomes in pooled analysis
Endovascular thrombectomy

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No symptoms</td>
</tr>
<tr>
<td>1</td>
<td>No significant disability. Able to carry out all usual activities despite some symptoms</td>
</tr>
<tr>
<td>2</td>
<td>Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities</td>
</tr>
<tr>
<td>3</td>
<td>Moderate disability. Requires some help, but able to walk unassisted</td>
</tr>
<tr>
<td>4</td>
<td>Moderate severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted</td>
</tr>
<tr>
<td>5</td>
<td>Severe disability. Requires constant nursing care and attention, bedridden, incontinent</td>
</tr>
<tr>
<td>6</td>
<td>Dead</td>
</tr>
</tbody>
</table>

Improvement in neurological outcomes at 90 days
Thrombectomy technique

Case

- 75-year-old female with multiple medical problems presented to local hospital with right hemiparesis and aphasia
- Patient received IV rTPA and transferred to OSU
- CTA demonstrated left M1 occlusion
Case

- 30-year-old female presented with left facial droop and subtle left weakness
- Her exam deteriorated to somnolence and unable to follow commands
- CT brain demonstrated no hemorrhage
- CTA brain concerning for basilar occlusion
Decompressive hemicraniectomy
Case

- 63-year-old male presented with right-sided weakness and aphasia
- CT demonstrated no hemorrhage
- CTA demonstrated no large vessel occlusion
- 30 hours after presentation, patient become somnolent