Critical Care Management of Acute Ischemic Stroke
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June 1, 2012

Disclosures
• Nothing to disclose

Selected slides courtesy of Wade Smith, MD, PhD

Overview
• Acute stroke interventions
• Blood pressure management
• Post-stroke cerebral edema
• Antithrombotic agents
• General ICU care
Pathophysiology

- Time dependent
- Focal ischemia is different from global ischemia
- Energy failure -> Ca$^{++}$ entry and cell death
- Glutamate toxicity
- Apoptosis

Revascularization Therapy

- t-PA
  - IV t-PA is approved in US for AIS within 3 hours of symptom onset
  - 3 to 4.5 hour window is effective (ECASS-III)

  [Image: Thrombolysis with Allopase 3 to 4.5 Hours after Acute Ischemic Stroke]

- IA Lytics
  - PROACT-II trial supports benefit from IA pro-urokinase; t-PA is used off label

- Mechanical Embolectomy
  - Devices do open vessels and have FDA clearance to open vessels
  - 2 ongoing, 1 in planning, studies to establish clinical efficacy
**Acute stroke interventions**

- **IV t-PA**
  - Proven
  - Approved

- **IA pro-UK**
  - Proven
  - Unapproved

- **Thrombectomy**
  - Unproven
  - Approved

**Time from stroke symptom onset (hr)**

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**HTN after Acute Stroke**

- Acute HTN is common after acute stroke
- Current guidelines suggest treatment for SBP > 220 mmHg or DBP > 120 mmHg or if evidence of end-organ damage
- With thrombolytic therapy, goal BP < 180/105 mmHg
- Risk of acute deterioration with aggressive reduction of BP
- Blood pressure reduction within 24 hours is associated with poor outcome
  - OR 1.89 per 10% decrease \( p = 0.047 \) of poor outcome at 3 months

*Neurology 2002; 61:1047-51*

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**Blood pressure goals**

- Optimal blood pressure after acute stroke is controversial
  - t-PA limit 185/110 mmHg
  - Lower BP by 15% if exceeds 220/120
  - Choice of BP agent is controversial; labetolol, nicardipine don’t raise ICP
**Ischemic Stroke Penumbra**

- **Collateral Flow**
- **Thrombus**

**Induced Hypertension**

- **For**
  - May increase pial-pial blood flow
  - Increase perfusion to the ischemic penumbra
  - Is probably safe

- **Against**
  - Requires ICU care and central line access
  - May cause coronary or gut ischemia
  - Could cause cerebral vasoconstriction

**Induced Hypertension**

- **Rordorf, et al, 1997**
  - Retrospective safety study in acute stroke patents
    - 30 controls vs. 30 treated with neosynephrine
    - 10/30 treated patients had BP threshold
    - No increased cardiac morbidity
Cerebral edema

- Posterior fossae strokes should be treated with suboccipital decompression if brainstem is compressed
- Hemicraniectomy for hemispheric stroke is proven to reduce mortality and improve outcomes (Level 1 evidence)
- Mannitol and hyperventilation not validated but are important bridges to surgical interventions as necessary
- Follow Na+
- No indication for corticosteroids
- Cooling

Hemicraniectomy in Ischemic Stroke

- Decompressive surgery to decrease mass effect and tissue shift after ischemia is controversial.
- Evidence of benefit in patient populations such as trauma, SDH, mass lesions and posterior fossa strokes.
- Variable outcomes in large hemispheric “malignant” infarcts.
Hemicraniectomy in Ischemic Stroke

• Case reports and anecdotal series show improved survival
• Improved morbidity associated with:
  – Younger age
  – Non-dominant hemisphere
  – Absence of complicating medical factors
  – Timing before signs of mesencephalic dysfunction

HeaDDFIRST

• Hemicraniectomy and Durotomy for Deterioration From Infarction Relating Swelling Trial
  – Prospective, multicenter clinical trial evaluating hemicraniectomy/durotomy vs. medical therapy
  – Unilateral MCA territory strokes within 12 hours
  – CT and clinical criteria of malignant MCA infarct
  – Standardized hemicraniectomy and durotomy
  – Outcomes will include long-term morbidity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Late</th>
<th>Early</th>
<th>Historical</th>
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</thead>
<tbody>
<tr>
<td>Age, y, mean±SD</td>
<td>48.8±12.4</td>
<td>50.3±18.4</td>
<td>56.0±19.4</td>
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<tr>
<td>Hemisphere</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>26</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>Left</td>
<td>6</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>SSS score on admission</td>
<td>14.6±6.8</td>
<td>21.5±8.4</td>
<td>19.5±7.6</td>
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<tr>
<td>Delay from onset to surgery</td>
<td>39 h</td>
<td>21 h</td>
<td>...</td>
</tr>
<tr>
<td>Herniation before surgery</td>
<td>75% [24/32]</td>
<td>13% [4/31]</td>
<td>...</td>
</tr>
<tr>
<td>Mortality rate</td>
<td>34.4% [11/32]</td>
<td>16% [5/31]</td>
<td>78% [43/55]</td>
</tr>
<tr>
<td>Time on NCCU, (d)</td>
<td>13.3</td>
<td>7.4</td>
<td>12.6</td>
</tr>
<tr>
<td>Barthel Index score, mean</td>
<td>62.6</td>
<td>68.8</td>
<td>60</td>
</tr>
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</table>
Antithrombotic Therapy for Stroke

Antithrombotic agents

- Avoid routine use of heparin
- Aspirin alone is the only proven strategy within the first 24-48 hours
- Dural sinus thrombosis and arterial dissection may specifically benefit from heparin

Secondary Prevention

- Antiplatelet
  - ASA within 24-48 hours of onset
  - Clopidogrel or asa+persantine first line by discharge
- Anticoagulants
  - Warfarin for atrial fibrillation
Low molecular weight heparin

• LMWHs and heparinoids reduce the risk of venous thromboembolic events
  – DVT OR 0.27 (CI 0.08-0.96)
  – PE OR 0.34 (CI 0.17-0.69)
• No significant reduction in death and disability OR 0.87 (CI 0.72-1.06)
• Significant increase in major systemic hemorrhages (OR 2.17) but not ICH (OR 1.7)

Bath, P et al. Stroke 2000

General ICU Care

• Airway
• Blood pressure
• Temperature
  – Treat fever with antipyretics
  – Cooling blankets, endovascular treatments not proven to change outcome
  – Hypothermia is experimental at present

Glucose management

• Glucose
  – Treat hypoglycemia immediately
  – Keep serum glucose < 140 mg/dL
  – Infusion vs. sliding scale insulin is controversial
**Nutrition**

- Assess and document swallowing
- Discourage rule of NPO X 24 hour as a standard
- NG tube is preferred if swallowing is unsafe
- Start feeds as soon as possible

**DVT prophylaxis**

- Compression devices unless DVT present
- Both SQ unfractioned heparin and LMWH are safe and effective to prevent venous clot and likely PE

**Stroke Centers**

- System approach for stroke shown to improve outcomes
- Pre-printed orders, leadership, QA, connection to community/EMS
- JC accreditation and auditing
- Comprehensive stroke centers with endovascular capability certification coming