Surgical Management of Stroke

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Stroke

- Stroke kills almost 130,000 Americans each year.
  - Third cause of all deaths in Arkansas.
  - Death Rate is highest in the entire country

- On average, one American dies from stroke every 4 minutes

- Every year, more than 795,000 people in the United States have a stroke.

- About 87% of all strokes are ischemic strokes, when blood flow to the brain is blocked

- Estimated $36.5 billion each year in costs

- Leading cause of serious long-term disability
Stroke Death Rates, 2014 - 2016
Adults, Ages 35+, by County

Rates are spatially smoothed to enhance the stability of rates in counties with small populations.

Data Source:
National Vital Statistics System
National Center for Health Statistics

CDC
Stroke

• Ischemic
  – atherosclerotic
  – cardiogenic

• Hemorrhagic
  – Hypertensive
  – Vascular
    • aneurysmal
    • AVM, cavernoma
Stroke

To Cut or Not to Cut?
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Who, What, When and Why?

- Factors:
  - Location, location, location
  - Age
  - comorbidity
  - Timing (early vs late)
  - ethics
  - cost
What?

- Malignant MCA territory infarction
  - 10% of strokes
  - rapid progressive deterioration
    - 48 hours or less
  - Mortality ~80%
    - Cerebral edema
    - Herniation
What?

• Malignant MCA territory infarction
  – Mortality risk factors:
    • early obtundation
    • dense hemiplegia
    • age 45-50
    • early parenchymal hypodensity involving >50% of MCA territory
    • Midline shift: 8-10mm
    • Hyperdense MCA sign
Guidelines

• Treatment:
  – supportive
    • BP for perfusion
    • intubation
    • glycemic control
  – ICP management
    • ICP monitor
    • CSF Diversion
  – Hyperosmolar therapies
    • Mannitol
    • Hypertonic Saline
  – Surgery
Surgery

• Hemicraniectomy
Guidelines

• Age < 70?
• nondominant vs dominant hemisphere
  – ethical question
• evidence for large territorial infarction or signs of impending herniation on imaging
• Post admission neurologic deterioration
Hemicraniectomy

• Mortality
  – May reduce mortality to as low as 32% in nondominant hemisphere strokes
    • as low as 39% in all comers
    – Alexander, Paul et al. “Hemicraniectomy versus medical treatment with large MCA infarct: a review and meta-analysis” *BMJ open* vol. 6,11 e014390. 24 Nov. 2016, doi:10.1136/bmjopen-2016-014390
Hemicraniectomy

- Morbidity
  - Modified Rankin score 0-3: No symptoms - moderate disability (able to walk)
  - 43% (surgical group) vs 21% (medical group)

- Park, Jaechan and Jeong-Hyun Hwang. “Where are We Now with Decompressive Hemicraniectomy for Malignant Middle Cerebral Artery Infarction?” *Journal of cerebrovascular and endovascular neurosurgery* vol. 15,2 (2013): 61-6.

When?

- Within **48 hours**
  - No evidence for improvement in functional outcome with decompression > 96 hours after stroke
WHO?

- **Age 18-60 “ish”**
  - Major current randomized trials included age ranges from 18-55 or 60 only
  - DESTINY II trial:
    - only 7% of pts > 60 were able to walk
    - none were independent
- **Infarct volume >145 cc on diffusion-weighted-images (DWI),**
  - One analysis found a high specificity of 98% for the development of MMCAI if the DWI lesion was >82 cc
Cerebellar Stroke

• Location
  – PICA
  – SCA
  – AICA

• Complications
  – Hydrocephalus
  – brain stem compression
Cerebellar Stroke
Cerebellar Stroke

- Relatively Rare
  - 1/5 of ischemic strokes
- PICA stroke:
  - inferior vermis and tonsils
- SCA:
  - superior hemisphere or vermi
Cerebellar Stroke

• Early findings:
  – dizziness/vertigo
  – nausea/vomiting
  – loss of balance
  – headache
  – signs: ataxia/nystagmus/dysarthria

• Late findings:
  – obtundation
  – brainstem compression: typically findings associated with lower pons (loss lateral gaze, facial paralysis, small pupils)
  – coma, posturing, ataxic respirations and respiratory failure
Cerebellar Stroke

• Indications for surgery:
  – Hydrocephalus
  – progressive brainstem compression
    • must distinguish between Lateral Medullary Syndrome related to stroke. LMS not accompanied with altered sensorium
    • 80% fatal without intervention

• Surgery:
  – External ventriculostomy drain with caution
  – Suboccipital craniectomy w/ foramen magnum enlargement and debridement of infarcted brain
Cerebellar Stroke

• Outcomes of surgery:
  – German-Austrian Space-Occupying Cerebellar Infarction Study (GASCIS)
  – Series of 84 patients with massive cerebellar infarction:
    • 40% required surgical craniotomies
    • 17% were managed with ventricular drainage
    • In this series, 74% of patients had very good outcomes.
Intracerebral Hemorrhage
ICH

• Locations:
  – Putaminal (most common)
  – Thalamoperforators
  – paramedian branches of Basilar artery
    • Pontine ICH
  – Lobar (underlying structural lesion likely)
  – Cerebellar
ICH

• **STICH** (International Surgical Trial in Intracerebral Hemorrhage)
  – 1033 patients enrolled
  – BG or lobar ICH
  – Surgery within 24 hours with possible surgery after 24 hours if deterioration despite medical management
• **Outcome:**
  – Only 26% favorable outcome vs 24 % in medical management
  – Subgroup analysis:
    • **1cm or less** from the cortical surface
STICH II

- 600 patients
- ICH volume 10-100 mL
- No IVH
- Evacuation within 12 hours plus medical treatment vs medical management alone with option for later surgical intervention for deterioration
STICH II

• Outcome:
  – Mortality 18% vs 24%
  – Surgery group had no vegetative survivors
    • Trend to better GOS

  – Subgroup Analysis
    • Pts with GCS 9-12 have more favorable outcome with surgery
    • GCS 13-15: no survival advantage with early surgery
      – option for delayed surgery with deterioration
ICH Guidelines

Non-Surgical

- Minimal symptoms
  - small volume < 30 cc
- Situational:
  - High ICH score
  - extensive ICH
    - Large volume > 60cc
    - dominant hemisphere
- age >75
- severe coagulopathy
- deep putaminal/BF ICH

Surgical

- ICH w/ mass effect and symptoms related to increased ICP
- rapid deterioration
- Moderate volume =30-60 cc
- location
  - lobar
  - cerebellar
- Young patient < 60
Intraventricular Hemorrhage
IVH

- Mortality ~80%
- Associated with hydrocephalus
- Current guidelines for surgical intervention directed at HCP management with CSF diversion
IVH

• CLEAR trials I-III
  – EVD with rTPA administration
    • rTPA 1mg Q8 hours up to 12 doses or until ventricles cleared
  – Early results showed improved clearance of blood from ventricles
  – Inclusion criteria required casting of 3rd and 4th ventricles with small volume (<30cc) ICH.
  – Deemed safe in selected patients
  – 19% death rate vs 29% with saline
  – 49% adverse events vs 62%
  – Only 3% difference in disability score
Thank You!