Hemorrhagic Stroke

Bi-State Stroke Consortium

Fran Hardaway, MD
Neurological Surgery
Disclosures

• No disclosures
But first... A little about me...

- Research Hospital
- Menorah Hospital
Research

Comparison of postoperative outcomes among patients treated by male and female surgeons: a population based matched cohort study

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Cite this as: BMJ 2017;359:j4366

Christopher JD Wallis, resident¹ ², Bheeshma Ravi, surgeon and assistant professor³, Natalie Coburn, surgeon and associate professor⁴, Robert K Nam, surgeon and professor¹, Allan S Detsky, internist and professor² ⁵, Raj Satkunasivam, surgeon and assistant professor¹ ⁶

• Women surgeons have better outcomes than men surgeons...

• Not relevant to this talk, but interesting...
Again... A little about me...

- Research Hospital
- Menorah Hospital
Objectives

• Provide a greater understanding about intracerebral hemorrhagic stroke (ICH) in adults
  • Etiology
  • Natural history
  • Prognosis

• Management of hemorrhagic stroke
  • Assessment and imaging
  • Medical versus surgical management
  • Relevant trials and updated guidelines

• Understand how to do a neurological exam on a comatose patient
Intracranial hemorrhage (ICH) in adults

• 2nd most common cause of stroke
  • 10-15 % first ever strokes

• 30 day mortality rate 35-52% *

• 70,000 – 80,000 cases per year in US

• 30-40% mortality rate**

• 20-40 % of those with ICH expected to make functional recovery at 6 months.


Risk factors

- **Hypertension** (relative risk of ICH is 3.9-5.4)
- Age (2x per decade)
- Men
- African American
- Previous CVA (25:1)
- Alcohol (2x)
- Cocaine/amphetamines
- Liver disease
Brain damage in ICH

- Tissue disruption
- Hematoma Enlargement
- Ischemic Penumbra
- Heme toxicity, inflammation
Differential Diagnosis for spontaneous, non-traumatic ICH

• Hypertensive Hemorrhage
• Amyloid angiopathy
• Vascular anomalies
  • Aneurysm rupture, AVM, Cavernous malformation
• Cerebral vessel occlusion related
  • Hemorrhagic conversion of ischemic stroke
  • Cerebral venous thrombosis
• Tumor (primary or metastatic)
  • Renal cell, melanoma, choiocarcinoma, thyroid
Deep hypertensive hemorrhage vs Lobar (amyloid) hemorrhage
Microbleeds in Amyloid

Common symptoms

- Sudden focal neurological deficit that progresses over minutes to hours
- Symptoms dependent on location size, degree of mass effect
- Headache
- Vomiting
- Coma
But wait, How can I neurologically assess a patient in a coma?

- GCS score
  - 3 components
  - Possible scores 3-15
  - If GCS < 8, Intubate
  - If GCS > 8 consider not intubating and waiting for neurosurgery to assess! (this is much appreciated!)

- Assess prior to intubation
## Glasgow Coma Score (GCS)

<table>
<thead>
<tr>
<th>Response</th>
<th>Scale</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye Opening Response</strong></td>
<td>Eyes open spontaneously</td>
<td>4 Points</td>
</tr>
<tr>
<td></td>
<td>Eyes open to verbal command, speech, or shout</td>
<td>3 Points</td>
</tr>
<tr>
<td></td>
<td>Eyes open to pain (not applied to face)</td>
<td>2 Points</td>
</tr>
<tr>
<td></td>
<td>No eye opening</td>
<td>1 Point</td>
</tr>
<tr>
<td><strong>Verbal Response</strong></td>
<td>Oriented</td>
<td>5 Points</td>
</tr>
<tr>
<td></td>
<td>Confused conversation, but able to answer questions</td>
<td>4 Points</td>
</tr>
<tr>
<td></td>
<td>Inappropriate responses, words discernible</td>
<td>3 Points</td>
</tr>
<tr>
<td></td>
<td>Incomprehensible sounds or speech</td>
<td>2 Points</td>
</tr>
<tr>
<td></td>
<td>No verbal response</td>
<td>1 Point</td>
</tr>
<tr>
<td><strong>Motor Response</strong></td>
<td>Obey commands for movement</td>
<td>6 Points</td>
</tr>
<tr>
<td></td>
<td>Purposeful movement to painful stimulus</td>
<td>5 Points</td>
</tr>
<tr>
<td></td>
<td>Withdraws from pain</td>
<td>4 Points</td>
</tr>
<tr>
<td></td>
<td>Abnormal (spastic) flexion, decorticate posture</td>
<td>3 Points</td>
</tr>
<tr>
<td></td>
<td>Extensor (rigid) response, decerebrate posture</td>
<td>2 Points</td>
</tr>
<tr>
<td></td>
<td>No motor response</td>
<td>1 Point</td>
</tr>
</tbody>
</table>

*Minor Brain Injury* = 13-15 points;  *Moderate Brain Injury* = 9-12 points;  *Severe Brain Injury* = 3-8 points
GCS

- Motor component
  - 6 Follows commands
  - 5 Localizes to pain
  - 4 Withdraw to pain
  - 3 Flexion
  - 2 Extension
  - 1 no response
Example GCS

- 46 year old male with a right basal ganglia IPH. SBP 290/100
  - Exam:
    - Opens eyes when you scream his name
      - E3
    - Mumbles incoherently, moans
      - V2
    - When you pinch his upper arm, he brings his other hand up to the stimulus to swat you away.
      - M5
  - $3 + 2 + 5 = GCS 10$ !!
Tips on examining an intubated/comatose patient

- Pause sedation
- Do Neuro assessment same way every time
- Level of consciousness
  - Awake/alert, confused, lethargic
- Eyes
  - Eyes open spontaneously? Open to voice? Open to pain? Do not open?
  - Check pupils
- Cough/gag reflex, overbreathing the ventilator?
- Do they follow commands
  - Show 2 fingers, give thumbs up, wiggles toes. Do dedicated strength testing if able.
- IF not following commands (6), do they localize (5), withdraw (4), flex (3), extend(2) or nothing (1)
Time sensitive issues

• Lower blood pressure
  • SBP < 140 (current AHA Class IA evidence) *

• Reverse coagulopathy.. Are they on blood thinners… if so, reverse!

• Head CT

Aggressive Blood pressure Lowering

- Current AHA guidelines suggest SBP < 140 as guideline for acute ICH.
- INTERACT2 study found better outcomes if blood pressure was < 140
  - Reduction in Death and disability
  - Better functional recovery

The NEW ENGLAND JOURNAL of MEDICINE

Rapid Blood-Pressure Lowering in Patients with Acute Intracerebral Hemorrhage

Craig S. Anderson, M.D., Ph.D., Emma Heeley, Ph.D., Yining Huang, M.D., Jiguang Wang, M.D.,
Christian Stapf, M.D., Candice Delcourt, M.D., Richard Lindley, M.D., Thompson Robinson, M.D.,
Pablo Lavados, M.D., M.P.H., Bruce Neal, M.D., Ph.D., Jun Hata, M.D., Ph.D., Hisatomi Arima, M.D., Ph.D.,
Mark Parsons, M.D., Ph.D., Yuechun Li, M.D., Jinchao Wang, M.D., Stephane Heritier, Ph.D., Qiang Li, B.Sc.,
Mark Woodward, Ph.D., R. John Simes, M.D., Ph.D., Stephen M. Davis, M.D., and John Chalmers, M.D., Ph.D.,
for the INTERACT2 Investigators*
Assessing and Managing a patient with an ICH

- Exam / Stat head CT
- Treat blood pressure (with arterial line monitoring and IV infusion – ie nicardipine )
- Make sure INR and platelets are normal, if not… correct them
- → transfer to ICU ASAP *
- → Care in a neuroscience ICU has been associated with a lower mortality**

Reversing Coagulopathies

- Risk of ICH doubles for every 0.5 points in the INR above 4.5
- Degree if INR elevation also correlates with hematoma expansion and prognosis
Reversing Coagulopathies

- **Vitamin K**
- **FFP**
  - Replenishes vitamin K depend coagulation factors inhibited by warfarin
  - Requires large volumes of plasma (slow) – heart failure
  - Variable concentrations of clotting factors
- **Prothrombin complex concentrate**
  - Contain Vitamin K-dependent factors (2, 7, 10) and factor 9 complex concentrates contain factors 2, 7, 9, 10.
- **rFVIIa** *(off label and guidelines usually recommend AGAINST this)*
  - does decrease growth of hematoma, but does not alter outcome
  - Associated with a higher risk of MI
  - ?May be ok to use of dibigatran (not apixabam or rivaroxiban)

What next?

- Because sudden focal neurological deficits can be caused by either ischemic or hemorrhagic stroke, you must differentiate with a head CT
- Look at the CT scan
White things on CT- the 3 B’s

• Blood  
• Bone  
• Bullets
White things on CT

- Basal Ganglia Hemorrhage

Bone is white
Intracranial hemorrhage

Metal/bullets are white on head CT

Cerebellar hemorrhage
Is this hemorrhage?

- No.
- Calcification is also white on head CT
ICH with intraventricular hemorrhage

Blood in ventricle

Hemorrhage in right thalamus/basal ganglia

EVD in ventricle
Hydrocephalus due to hemorrhage in ventricle
ICH from a bleeding Tumor
Complications

- Rebleeding: more common in basal ganglia hemorrhage than in lobar
  - Incidence of hematoma enlargement decreases with time
    - \( \sim 35\% \) in 1-3 hours
    - 16\% in 3-6 hours
    - 14\% at 24 hours

- Late Rebleeding – more likely if underlying vascular malformation or amyloid

- Edema and ischemic necrosis

- Hydrocephalus

- Seizures*
  - Prophylactic AEDs are NOT recommended

Prognosis

- Neurological status (GCS score)
- Volume of ICH
- Age
- Intraventricular extension
- Hydrocephalus
- Good outcomes
  - Cortical location, mild neurological dysfunction
ICH score*

- A risk stratification score that includes 5 independent factors that predict 30 day mortality rate

Mortality based on ICH score

Approaches to ICH treatment

• Reduce progression of bleeding
  • Correcting coagulopathy or giving procoagulant
  • Blood pressure control

• Reduce mass effect
  • Hematoma removal

• Give swollen brain more room
  • Decompressive hemicraniectomy
  • External Ventricular Drain
External Ventricular drain (ventriculostomy)

Medical Management

• Medical
  • Blood pressure control – prevent rehemmorhage
  • < 140
  • ICP control
    • Positioning HOB at 30-45
    • hypertonic saline, External ventricular drain
  • General medical management (glucose, normothermia)
  • Reversing coagulopathies
    -FFP and vitamin K
    -PCC – faster but shorter half life
Surgical treatment

- Craniotomy and clot evacuation
  - Most studied
  - Removal of mass effect, removal of blood products, helping prevent edema and secondary brain injury
- Decompressive craniectomy
- Ventriculostomy
Surgical treatment of ICH

- International Trial in Intracerebral Hemorrhage (STITCH)
  - Randomized 1033 patients over 8 years to medical or craniotomy
  - Eligibility:
    - within 72 hours of ictus
    - operated on within 96 hours
    - Clot > 2 cm diameter
    - Clot supratentorial
  - Excluded if GCS < 5
  - Primary outcomes: incidence death and disability (eGOS) at 6 months
  - Secondary outcomes: death, the mRS at 6 months
• 506 patients randomized to surgery and 530 to medical therapy.
  • 26 % (n=140) of medical arm crossed over to surgery (due to rebleeding or deterioration)
  • 75% of Surgical arm underwent craniotomy (others treated with less invasive surgical techniques)
### Table 3: Surgery details

<table>
<thead>
<tr>
<th>Time between ictus and surgery (h)</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 (16-49)</td>
<td>60 (27-99)</td>
</tr>
<tr>
<td>surgical surgery, 12 h from ictus</td>
<td>74 (16%)</td>
<td>7 (5%)</td>
</tr>
<tr>
<td>Time between randomisation and surgery (h)</td>
<td>5 (2-12)</td>
<td>31 (11-82)</td>
</tr>
<tr>
<td>surgical surgery, 12 h from randomisation</td>
<td>339 (73%)</td>
<td>35 (25%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surgical method</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craniotomy</td>
<td>346 (75%)</td>
<td>119 (85%)</td>
</tr>
<tr>
<td>Burrhole</td>
<td>37 (8%)</td>
<td>10 (7%)</td>
</tr>
<tr>
<td>Endoscopy</td>
<td>31 (7%)</td>
<td>7 (5%)</td>
</tr>
<tr>
<td>Stereotaxy</td>
<td>34 (7%)</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Other</td>
<td>16 (3%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Not recorded</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional neuro procedure</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-evacuation</td>
<td>27 (6%)</td>
<td>8 (6%)</td>
</tr>
<tr>
<td>External ventricular drain</td>
<td>18 (4%)</td>
<td>8 (6%)</td>
</tr>
<tr>
<td>Intracranial pressure monitoring</td>
<td>10 (2%)</td>
<td>4 (3%)</td>
</tr>
<tr>
<td>Other</td>
<td>12 (3%)</td>
<td>4 (3%)</td>
</tr>
<tr>
<td>Not recorded</td>
<td>5 (1%)</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status before evacuation</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paralysed and sedated</td>
<td>64 (14%)</td>
<td>23 (16%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glasgow coma score (n=465)</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-8</td>
<td>94 (24%)</td>
<td>85 (73%)</td>
</tr>
<tr>
<td>9-12</td>
<td>157 (40%)</td>
<td>25 (22%)</td>
</tr>
<tr>
<td>13-15</td>
<td>145 (37%)</td>
<td>6 (5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Affected arm</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>42 (9%)</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Weak</td>
<td>113 (24%)</td>
<td>17 (12%)</td>
</tr>
<tr>
<td>Paralysed</td>
<td>239 (51%)</td>
<td>88 (63%)</td>
</tr>
<tr>
<td>Not assessable/not recorded</td>
<td>71 (15%)</td>
<td>32 (23%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Affected leg</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>49 (11%)</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Weak</td>
<td>129 (28%)</td>
<td>22 (16%)</td>
</tr>
<tr>
<td>Paralysed</td>
<td>216 (46%)</td>
<td>83 (59%)</td>
</tr>
<tr>
<td>Not assessable/not recorded</td>
<td>71 (15%)</td>
<td>32 (23%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speech</th>
<th>Early surgery (n=465)</th>
<th>Initial conservative treatment (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>102 (22%)</td>
<td>11 (8%)</td>
</tr>
<tr>
<td>Dysphasic</td>
<td>93 (20%)</td>
<td>11 (8%)</td>
</tr>
<tr>
<td>Aphasic</td>
<td>130 (28%)</td>
<td>37 (26%)</td>
</tr>
<tr>
<td>Not assessable/not recorded</td>
<td>140 (30%)</td>
<td>81 (58%)</td>
</tr>
</tbody>
</table>

Data are number (%) or median (IQR).
Results of STITCH trial

- No significant difference between early surgical and initial conservative management groups.

- Of the subgroups examined, patients with an ICH within a centimeter of the cortical surface showed a non-significant trend toward benefit with early surgery.

- Median time to surgery in the “early surgery group” was about 30 hours (16-49). Only 16 percent had surgery within first 12 hours.

- Mild benefit for surgical removal of superficial hematomas but no benefit overall → demonstrates patients with deep ICHs randomized to early surgery do more poorly.

- With patients who presented with GCS< 8, early surgery raised the relative risk of poor outcome for these patients.
STITCH subgroups

• 1- Outcomes worse –
  • Surgery for deep hemorrhages or those associated with IVH

• 2 – Outcomes better
  • Surgery for Lobar hemorrhages
  • -conservative treatment – 37 % good outcome
  • -Surgical treatment – 49 % good outcome
STITCH trial conclusions

• Trends (despite insignificance) point to possible better outcomes in Craniotomy group in those with
  • GCS 9-12,
  • lobar clots,
  • clots < 1 cm from surface

• Those with GCS 5-8 tended to do better with medical management

• Surgery at one day or longer after onset is not better than initial conservative medical treatment with or without craniotomy for patients who have deteriorated. There is a non-significant benefit of 5% in favor of early surgery (P=0.166).
Consensus statement from AHA guidelines

- “Delayed evacuation by craniotomy appear to offer little if any benefit with a fairly high degree of certainty. In those patients presenting in coma with deep hemorrhages, removal of ICH by craniotomy may actually worsen outcome and is not recommended.”
Is earlier surgery better?

- Rebleeding occurs in:
  - 40% of patients operated on within 4 hours of onset
  - 12% of patients operated on 4-12 hours of onset

- Recommendation
  - Surgery 6 hours or more after onset unless actively deteriorating

<table>
<thead>
<tr>
<th>NON-SURGICAL</th>
<th>SURGICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimally symptomatic (GCS &gt;10)</td>
<td>Lesions with MLS, herniation</td>
</tr>
<tr>
<td>Hemorrhage in the brainstem</td>
<td>brainstem compression</td>
</tr>
<tr>
<td>Little chance of good outcome</td>
<td>Volume: moderate (10-30cc)</td>
</tr>
<tr>
<td>High ICH score</td>
<td>Favorable location</td>
</tr>
<tr>
<td>dominant hemisphere</td>
<td>lobar</td>
</tr>
<tr>
<td>GCS&lt; 5</td>
<td>cerebellar* (class I level B)</td>
</tr>
<tr>
<td>Age over 75</td>
<td>Young patient</td>
</tr>
<tr>
<td>Basal Ganglia or thalamus: surgery is no better</td>
<td></td>
</tr>
<tr>
<td>than medical management</td>
<td></td>
</tr>
</tbody>
</table>
In summary…

- Common causes of spontaneous non-traumatic ICH include hypertension, amyloid and coagulopathy.

- Goals of treatment of ICH:
  - controlling ICP
  - reducing mass effect
  - and preventing secondary injury (i.e., expansion of hemorrhage)

- The role for surgery in supratentorial spontaneous ICH is not clearly beneficial, but may be useful in patients with superficial lobar bleeds with higher GCS on admission.
A 75 year old male presents with a gradually progressive hemiparesis and headache over the last few hours. CT shows a hemorrhage. His blood pressure is 195/100. GCS is 10. What should you do next?

- A) Treat blood pressure so it is < 180
- B) Treat blood pressure so it is < 140
- C) obtain an MRI
A 75 year old male presents to the ER with a gradually **progressive hemiparesis** and **headache** over the last few hours. CT shows a hemorrhage. His blood pressure is **195/100**. GCS is **10**. What should you do next?

- A) SBP < 180 (not quite)
- B) Treat blood pressure so it is < 140
- C) Obtain an MRI (Don’t do this)

**Current guidelines recommend immediate lowering to < 140.** Also… Call Neurosurgery and alert ICU of incoming transfer!
Thank you!

• Questions?
References


