“The Worst Headache of My Life”
Hemorrhagic Stroke

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Objectives

– Identify the risk factors for both intraparenchymal hemorrhage (IPH) and aneurysmal subarachnoid hemorrhage (aSAH)

– Recognize signs and symptoms of IPH and aSAH

– Demonstrate understanding of the treatment plan for IPH and aSAH
IPH
IPH

• Incidence
  – 12-31 per 100,000 cases per year

• Mortality
  – Overall case-fatality 40% despite aggressive treatment

• Morbidity
  – Return to independence after 1 year 12-39%
  – National Burden: $34 billion
IPH

• Risk Factors
  – Anticoagulant use
  – Uncontrolled HTN
  – Smoking
  – Alcohol use
  – Hyperlipidemia
  – Vascular disorders: Amyloid Angiopathy
  – Emerging risk factors: Chronic Renal Dysfunction
ICH Score (Hemphill Score)

• Takes into account:
  – GCS
  – Age
  – ICH volume
  – Location of the clot
  – Intraventricular blood

• Predictor of 30 day mortality

• High Score = Increased Mortality
### ICH Score

<table>
<thead>
<tr>
<th>GCS</th>
<th></th>
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<tbody>
<tr>
<td>3-4</td>
<td>2 pts</td>
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<tr>
<td>5-12</td>
<td>1 pt</td>
</tr>
<tr>
<td>13-15</td>
<td>0 pts</td>
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<table>
<thead>
<tr>
<th>ICH volume</th>
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<tbody>
<tr>
<td>&gt; 30 cm³</td>
<td>1 pt</td>
</tr>
<tr>
<td>&lt; 30 cm³</td>
<td>0 pts</td>
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</table>

<table>
<thead>
<tr>
<th>IVH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1 pt</td>
</tr>
<tr>
<td>No</td>
<td>0 pts</td>
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<table>
<thead>
<tr>
<th>Location</th>
<th></th>
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<tbody>
<tr>
<td>Infratentorial</td>
<td>1 pt</td>
</tr>
<tr>
<td>Supratentorial</td>
<td>0 pts</td>
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<table>
<thead>
<tr>
<th>Age</th>
<th></th>
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<tbody>
<tr>
<td>&gt; 80 yrs</td>
<td>1 pt</td>
</tr>
<tr>
<td>&lt; 80 yrs</td>
<td>0 pts</td>
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</table>
Initial Management

• Non-contrast head CT
  – Definitive diagnosis

• Admission to a Comprehensive Stroke Center
  – Better outcomes and lower mortality

• Admission to a Neuroscience Care Unit

• Serial neuro exams
  – Intraventricular blood high risk for hydrocephalus and may need emergent CSF diversion

• Close airway monitoring
  – High risk for aspiration
  – Intubate early = PREVENT secondary injury
Medical Management

• Treatment
  – Reverse coagulopathy if possible
    • Newer anticoagulants may have no reversal agent
    • ? Dialysis
    • INR >4.0 Prothrombin Complex Concentrate
      – Factor II, VII, IX, X
      – Dose: 35units/kg
      – Recheck INR post-transfusion.
      – Contraindicated in heparin-induced thrombocytopenia
Medical Management

• Blood Pressure Control
  – AVOID variability in blood pressure
    • Independent risk factor for neurological deterioration and unfavorable outcomes
  – Initial SBP 150-220, reduce SBP <140 over 3-6 hrs
    • No difference in mortality or adverse events
    • Nicardipine vs Labetalol
  – SBP >220, continuous infusion and frequent BP monitoring is recommended
Medical Management

• Fever
  – Infectious vs Central
  – Patients with larger IPH volumes and presence of IVH at greatest risk for central fever

• Aggressive Normothermia
  – Higher mortality rates (80% vs 36%)
  – Worsened outcomes as measured by the modified rankin (≤ 2)
Medical Management

• Seizures
  – Incidence
    • Clinical: 16%
    • Subclinical: 28-31%
  – Higher cortical lesions more susceptible
  – AMS = EEG
  – Seizure prophylaxis NOT recommended
    • PPX with phenytoin increased death and disability in IPH
    • PPX with valproic acid revealed no decrease in incidence of seizures
  – Treatment
    • Neurology Consultation
    • Anti-epileptic medications
Surgical Management

• Clot removal
  – Cerebellar hemorrhages >3cm with/without brainstem compression had favorable outcomes with aggressive medical management
  – Lobar/Supratentorial: no evidence to support clot evac

• Decompressive Craniectomy
  – Not well studied
  – May improve mortality for comatose patients with large supratentorial clot burden
Preventing Complications

• Venous thromboembolism
  – 2011 Meta-analysis (4 trials, 2 RCTs) can begin chemical ppx (enoxaparin or heparin) as early as day 1-6 with no significant increase in hematoma expansion or mortality
  – Sequential Compression Device
  – Early ambulation, PT/OT

• Stress Ulcer
  – PPI or H2 if indicated

• Prevention of infection
  – Early removal of invasive lines, foley
  – High risk for aspiration. NPO until cleared by Speech Pathologist

• Skin
  – Daily assessment for breakdown
  – Frequent repositioning
Aneurysmal Subarachnoid Hemorrhage (aSAH)
Circle of Willis
aSAH

• Incidence
  – Accounts for 5% of all strokes
  – 30,000 ruptures/year
  – 6 million Americans have an unruptured cerebral aneurysm
  – Rupture every 18 minutes

• Morbidity/Mortality
  – 15% aSAH pts die before reaching a hospital
  – 40% mortality rate
  – Of those who survive, 66% will have a permanent neurological disability
aSAH

• Risk Factors:
  – Smoking
  – Smoking
  – Smoking
  – HTN
  – Genetic Predisposition
  – Female Gender
  – Alcohol and drug use (amphetamines, cocaine, etc)
<table>
<thead>
<tr>
<th>Grade</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>0</td>
<td>unruptured aneurysm</td>
</tr>
<tr>
<td>1</td>
<td>Asymptomatic, or minimal headache, nuchal rigidity</td>
</tr>
<tr>
<td>2</td>
<td>Moderate to severe headache, no neurologic deficit except for cranial nerve palsy</td>
</tr>
<tr>
<td>3</td>
<td>Drowsiness, confusion, mild focal deficit</td>
</tr>
<tr>
<td>4</td>
<td>Stuporous, moderate to severe hemiparesis, early decerebrate</td>
</tr>
<tr>
<td>5</td>
<td>Deep coma, decerebrate posturing, moribound</td>
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# Fischer Scale

## Fisher CT Grading Scale

<table>
<thead>
<tr>
<th>Fisher Group</th>
<th>Blood Pattern on Nonenhanced CT</th>
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<tbody>
<tr>
<td>1</td>
<td>No subarachnoid blood detected</td>
</tr>
<tr>
<td>2</td>
<td>Diffuse or vertical layers &lt; 1 mm thick*</td>
</tr>
<tr>
<td>3</td>
<td>Localized clot or vertical layers ≥ 1 mm thick</td>
</tr>
<tr>
<td>4</td>
<td>Intracerebral or IV clot with diffuse or no SAH</td>
</tr>
</tbody>
</table>

*Vertical* cisterns: interhemispheric, insular, and ambient.
Initial Management

- Head CT with/without contrast
- Admission to a Neuroscience Care Unit
- Serial neuro exams
- Control Blood Pressure – AVOID labile BP
  - SBP goal <140
  - Nicardipine, labetalol
  - At risk for aneurysmal re-rupture within the first 72hrs (60% mortality)
- Close airway monitoring
- SAH precautions
  - Lights low, minimal visitors, avoiding anything stressful
- Control Pain
  - Can be difficult
Surgical Management

• Hydrocephalus
  • Incidence 20-30%
  • Typically occurs within the first 48 hrs
  • Treatment: immediate CSF diversion with an external ventricular drain
  • Many will require ventriculoperitoneal shunt (31%)
Surgical Management:
Endovascular Embolization
Surgical Management: Open Clipping
Cerebral Vasospasm

• Incidence
  – Occurs in 30% of aSAH patients
  – Important cause of morbidity and mortality (14-36%)
  – Can potentially lead to ischemic strokes due delayed cerebral ischemia
  – If the patient survives the initial bleed, this is a major concern over the coming weeks.
Cerebral Vasospasm

- Typically occurs between post-bleed day 3-14
  - If nothing goes wrong, the patient will stay in the hospital for at least 2 weeks
- Pathophysiology: many theories but no proven pathology
- Medical Management
  - HTN & Euvolemia
  - The goal is to stent the vessels open with high blood pressure and fluid to prevent ischemic stroke
  - Titrate BP to exam
    - Can be as high as 260 systolic
- Surgical Management
  - Intra-arterial calcium channel blockers, balloon angioplasty
Medical Management

• Fever
  – Occurs in 72% of aSAH patients
  – Increases ischemic injury, raises intracranial pressure by exacerbating cerebral edema and alters the neuro exam
  – Linked to cerebral vasospasm
  – 1 episode of fever increases morbidity and mortality even in low grade aSAH
  – AGGRESSIVE treatment with goal normothermia
Medical Management

• Fever Continued......
  – Treatment
    • First line = antipyretics
      – Blocks prostagladin-E synthesis and lowers the hypothalamic set point
    • External cooling methods
      – Cooling blanket, iced fluids, etc
      – PREVENT shivering
    • Beware of Meningitis
      – Many patients require CSF diversion. Sample CSF with fever.
      – Antibiotic therapy should include CSF penetration
Medical Management

• Seizures
  – Occurs in approximately 26% of aSAH
    • Most occur pre-hospital
  – Risk Factors: middle cerebral artery territory aneurysm, presence of intraparenchymal clot, poor grade SAH, rebleeding and infarction
  – AMS = EEG
  – No data for seizure prophylaxis
Medical Management

• Cardiac Dysfunction
  – Neurogenic Stunned Myocardium
  – Typically occurs in high grade aSAH
    • Syncope = Echo
  – Pathophysiology
    • MAP = ICP at the time of aneurysmal rupture
    • Sympathetic surge, massive catecholamine release
  – Signs/Symptoms
    • Pulmonary edema upon arrival, low EF, fluctuating blood pressure and/or hypotension.
  – Treatment
    • Supportive Care
Case Study

A 57 y/o male is brought to the ER via EMS complaining of the worst headache of his life. Pt history includes coronary artery disease, recent stent placed to the LAD (3 months ago, on plavix), HTN, smoking and sleep apnea.
Case Study

What is the first test you would order?

A. CBC, BMP, Coags
B. Head CT with/without contrast
C. EKG, troponin
D. MRI/MRA
Case Study
Case Study

Based on this image, what is the most likely diagnosis?

A. Intracerebral Hemorrhage
B. Traumatic Subarachnoid Hemorrhage
C. Aneurysmal Subarachnoid Hemorrhage
D. I have no clue
Case Study

About an hour after arrival, the patient becomes lethargic and begins vomiting. What is *most likely* occurring?

A. A GI bug  
B. Hydrocephalus  
C. Cerebral Edema  
D. Subclinical Seizures
Based on the previous question, what treatment would the patient next require?

A. Anti-emetic
B. Immediate CSF diversion
C. Decompressive craniectomy
D. Anti-epileptics
24 hours after admission, an echo is performed and the patient’s EF is 15-20%. What is the most likely diagnosis?

A. Undiagnosed heart failure
B. Neurogenic stunned myocardium
C. Neither one of these
Questions???
References


References
