Blood on Head CT

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Blood in the Head... Oh, My!

- Is all blood in the head treated the same?
  - (N.B. This lecture will focus on nontraumatic intracranial bleeding)
- Who needs blood pressure control?
- Who needs antiseizure medications?
- Who needs other interventions?

Intracranial Hemorrhage

- Key Reference

Management of Spontaneous ICH

- Guideline for diagnosis and treatment of spontaneous intracranial hemorrhage
- Update of 2007 guideline
- Formal medical literature search used as basis of guideline

Management of Spontaneous ICH: Background

- Spontaneous ICH a significant cause of morbidity and mortality
- Aggressive management and excellent medical care have significant impact on outcomes

Management of Spontaneous ICH: Emergency Diagnosis

- Rapid diagnosis and management crucial
- Early deterioration is common – both prehospital and after arrival
- Prehospital management is to provide ventilatory and cardiovascular support and transport
- Secondary goal is obtaining history, circumstances, etc.
- Also, contact regarding imminent patient arrival
Management of Spontaneous ICH

**ED Issues**
- Should be prepared to manage or rapidly transfer
- Neurology, neuroradiology, neurosurgery and critical care facilities crucial
- Focus on obtaining pertinent history
  - Time of onset, vascular risk factors, medications (esp. anticoagulants or antiplatelet agents), recent trauma or surgery, history of dementia, alcohol or drug use, seizures, liver disease, cancer

**Tests**
- CBC, electrolytes, BUN/Cr, glucose, coagulation studies, tox screen, UA, urine culture, pregnancy test
- ECG
- CXR
- Neuroimaging

**Neuroimaging**
- Clinically very difficult to differentiate ischemic from hemorrhagic neurovascular event
- Some findings correlate with hemorrhage, but findings are not specific enough to ICH
- Neuroimaging mandatory
- CT and MRI both reasonable first choices
- CT current gold standard
- Gradient echo and T2 susceptibility-weighted MRI as sensitive as CT and more sensitive to predict prior hemorrhage

**Management**
- Multiple issues and challenges
- Few standardized pathways used
- Issues:
  - BP management
  - Intubation
  - Reversal of coagulopathy
  - Neuroimaging
  - Definitive consultation and intervention

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Management of Spontaneous ICH

**Neuroimaging Recommendations:**
- Rapid neuroimaging with CT or MRI recommended to distinguish ischemic stroke from hemorrhage
- CT angiography and contrast-enhanced CT may help identify patients at risk for hematoma expansion, and
- CT angio, CT venogram, contrast-enhanced CT, contrast-enhanced MRI, MRA, and MRV may be useful to find underlying structural lesions

Management of Spontaneous ICH: Medical Treatment

**Hemostasis / Antiplatelets / DVT Prophylaxis**
- Coagulopathy contributes significantly to ICH
- Patients on oral anticoagulants with life-threatening bleeding should be normalized as soon as possible
- Vitamin K and FFP are traditional
- Prothrombin complex concentrates (PCCs) and recombinant factor VIIa are potential therapies

**Prothrombin complex concentrates (PCCs)**
- Plasma-derived factor concentrates
- Contains primarily factor IX, but also II, VII and X
- Increasingly recommended for warfarin reversal
- Benefits:
  - Can be administered rapidly
  - High concentrations of factors in small volumes
  - Can rapidly normalize INR (minutes)
  - Faster than Vitamin K and FFP
  - Use is increasingly being recommended

**Recombinant factor VIIa**
- Potential treatment in patients on oral anticoagulants (OACs)
- Can rapidly normalize INR, but does not replenish vitamin K-dependent factors
- May not restore thrombin generation as well as PCCs
- NOT recommended for use in recent review by American Society of Hematology for warfarin reversal – even for ICH patients not on OACs

**Antiplatelet agents**
- Results conflicting
- Data conflicting on effect of platelet transfusions in ICH patients
- True effect not known at this time

**Hemostasis / Antiplatelets / DVT Prophylaxis**
- High risk of thromboembolic disease in ICH patients
- Intermittent pneumatic compression with elastic stockings shown effective at reducing risk of symptomatic DVT
- Role of additional anticoagulant unclear but no harm seen if ICH is stable
Management of Spontaneous ICH: Medical Treatment

- Hemostasis / Antiplatelets / DVT Prophylaxis
  - Recommendations:
    - If severe coagulation factor deficiency or thrombocytopenia, receive factor replacement or platelets, respectively
    - If on warfarin, withhold warfarin, replace factors with FFP and give IV vitamin K
    - PCCs are a reasonable method of replacement as alternative to FFP
    - Recombinant factor VIIa not routinely recommended as sole agent

- Recombinant Factor VIIa also not recommended in noncoagulopathic ICH patients
- Platelet transfusions in patients on antiplatelet agents is considered investigational

- Blood Pressure
  - Recommendations:
    - Management of BP based on incomplete efficacy evidence
    - Recommendations:
      - SBP > 200mmHg or MAP > 150mmHg, consider aggressive reduction with IV meds and monitor BP every 5 minutes
      - IF SBP > 180mmHg or MAP > 130mmHg and there is a possibility of elevated ICP, consider monitoring ICP and reducing BP by intermittent or continuous IV medications – CPP goal ≥ 60mmHg

- Study showed a trend toward lower ICH growth in intensively managed group
- No downside seen in this group
- Data insufficient to recommend definitive policy
- Guideline does present suggested management
Management of Spontaneous ICH: Medical Treatment

Blood Pressure Recommendations (cont.)
- Recommendations:
  - If SBP > 180mmHg or MAP > 130mmHg and no evidence of elevated ICP, consider modest reduction of BP (e.g. to MAP of 110mmHg or target BP 160/90) using intermittent or continuous IV meds and reexamine patient every 15 minutes
  - If SBP 150-220mmHg, acutely lowering BP to 140mmHg probably safe

Management of Glucose
- Elevated blood glucose correlates with increased mortality risk, but tight control risks hypoglycemic events
- Optimal management currently unknown
- Hypoglycemia should be avoided
- Recommendation: Glucose should be monitored and normoglycemia is recommended

Seizures and Antiepileptic Drugs
- Clinical seizures should be treated
- Continuous EEG monitoring probably indicated if depressed mental status out of proportion to degree of brain injury
- If found to have seizures on EEG, should be treated with antiepileptic drugs
- Prophylactic anticonvulsants should not be used

ICP Monitoring / Treatment
- If hematoma small and IVH limited, treatment to lower ICP usually not warranted
- Even in serious ICH, management of elevated ICP shows minimal impact on outcome
- ICP measuring devices are invasive and pose potential for complications
- If used, coagulation status should be evaluated and deficits corrected
- Consider ICP monitoring if GCS ≤ 8, clinical evidence of herniation, significant IVH or hydrocephalus

Inpatient Management and Prevention of Secondary Brain Injury
- Should be admitted to neuroscience ICU
- Frequent assessment needed
- Nurses skilled in caring for ICH patients critical part of the patient's care – improves outcomes
- Documentation includes vitals, detailed assessment of neurological function
- Bottom line: Admit to neuroscience ICU

Management of Temperature
- Presence of fever correlates with worse outcomes
- However, no data links fever treatment to outcome
- Cooling has not been systematically investigated

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Management of Spontaneous ICH: Medical Treatment

ICP Monitoring / Treatment
- Recommendations
  - If GCS ≤ 8, clinical evidence of transtentorial herniation, significant IVH or hydrocephalus, consider ICP monitoring and treatment
  - Goal is cerebral perfusion pressure of 50-70 mmHg
  - Ventricular drainage as treatment for hydrocephalus is reasonable in patients with decreased level of consciousness

Intraventricular Hemorrhage
- Occurs in 45% of spontaneous ICH patients
- Most are secondary – related to hypertensive hemorrhages involving basal ganglia and the thalamus
- Theoretical advantage of using thrombolytics to lyse intraventricular clot
- Minimal data on efficacy and outcomes
- Recommendation: Efficacy and safety of thrombolytics in IVH uncertain, considered investigational

Management of Spontaneous ICH: Medical Treatment

Clot removal
- Surgical treatment remains controversial
- Balance of limiting mechanical damage to surrounding tissue with risk of ongoing bleeding
- Often need to cut through uninjured brain to get to ICH, increasing potential for damage

Clot removal
- Most data exists on clot removal in cerebellar hemorrhage (10-15% of ICHs)
- If larger than 3cm or with brainstem compression or hydrocephalus – good outcomes with surgery (compared to those with medical management)
- Not from randomized, controlled trials
- Other locations have variable results with surgery, including some with worse outcomes

Minimally invasive surgical clot removal
- Techniques available
  - Stereotactic guidance combined with either thrombolytic-enhanced or endoscopic-enhanced aspiration
  - Trials show decreased mortality if done within 12-72 hours, but improved functional outcome not consistently demonstrated

Timing of surgical intervention
- Variance between studies makes drawing conclusions difficult
- Very early surgery (4 hours or less) shows worse outcomes
- Surgery less than 12 hours shows mixed results
- No clear timing benefit between 24, 48, 72, or 96 hours
Management of Spontaneous ICH

Surgery Recommendations:
- For most patients, usefulness of surgery is uncertain
- If cerebellar bleed deteriorating neurologically or with brainstem compression or hydrocephalus – should undergo surgical decompression
- If clot > 30mL and within 1cm of surface, surgery may be considered
- Minimally invasive clot evacuation is considered investigational
- No evidence that surgery improves functional outcome; very early surgery may be harmful

Outcome prediction and withdrawal of support
- Should avoid creating a self-fulfilling prophecy of guaranteed poor outcome
- Although outcomes are poor, some patients have functional survival
- Recommendation
  - Aggressive, full care early after ICH (unless preexisting DNR)
  - New DNR orders should be postponed until after day 2, at the earliest

Prevention of Recurrent ICH
- Recurrence rate 2.1-3.7% per patient-year for survivors
- There are some identified risk factors
  - Lobar location
  - Older age
  - Ongoing anticoagulation
  - Presence of specific alleles
  - Greater number of microbleeds on MRI
- Long term blood pressure control is recommended

Anticoagulant use associated with worse bleeds and risk of recurrence
- Must decide whether benefit outweighs risk
- Frequent alcohol use tied to increased risk of rebleed
- Unclear benefit of using statins
- No recommendations can be made regarding exertional activities

Rehabilitation and Recovery
- Studies problematic as they mix ischemic stroke, SAH and ICH patient populations
- Half of survivors of ICH remain dependent on others
- Recovery may continue indefinitely
- Well-organized, multidisciplinary inpatient stroke units improve recovery
- Recommendation
  - Reasonable that all patients with ICH have multidisciplinary rehabilitation
  - If possible, should be started as early as possible and continued through discharge and home care

Neuroimaging recommendations
- Rapid neuroimaging with CT or MRI recommended to distinguish ischemic stroke from hemorrhage
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Management of Spontaneous ICH: Summary

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- **Prophylaxis Recommendations:**
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  - If on warfarin, withhold warfarin, replace factors with FFP and give IV vitamin K.
  - PCCs are a reasonable method of replacement as alternative to FFP.
  - Recombinant factor VIIa not routinely recommended as sole agent.

**Blood Pressure Recommendations**
- **SBP > 200mmHg or MAP > 150mmHg,** consider aggressive reduction with IV meds and monitor BP every 5 minutes.
- **If SBP > 180mmHg or MAP > 130 mmHg,** and there is a possibility of elevated ICP, consider monitoring ICP and reducing BP by intermittent or continuous IV medications – CPP goal ≥ 60mmHg.
- **In patients presenting with SBP 150-220 mmHg,** acutely lowering BP to 140mmHg probably safe.

**Admission Recommendations**
- **Patients should be admitted to neuroscience ICUs.**
- Outcomes improved.

**Glucose Management**
- Optimal management of hyperglycemia needs to be clarified.
- Glucose should be monitored and normoglycemia is recommended.
- Hypoglycemia should be avoided.

Recombinant Factor VIIa also not recommended in noncoagulopathic ICH patients.
Platelet transfusions in patients on antiplatelet agents is considered investigational.
Management of Spontaneous ICH: Summary

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  - Clinical seizures should be treated
  - Continuous EEG monitoring probably indicated if depressed mental status out of proportion to degree of brain injury
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Management of Spontaneous ICH: Summary

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  - If clot > 30mL and within 1cm of surface, surgery may be considered

Management of Spontaneous ICH: Summary

- Surgery Recommendations (cont.):
  - Minimally invasive clot evacuation is considered investigational
  - No evidence that surgery improves functional outcome; very early surgery may be harmful

Management of Spontaneous ICH: Summary

- Outcomes
  - Aggressive support should be provided for at least the first 2 days unless already DNR
  - No DNR decisions should be made in the first 2 days
Management of Spontaneous ICH: Summary

Prevention of Recurrence
- Increased risk if lobar location, older age, ongoing anticoagulation, microbleeds
- BP should be well-controlled (to < 140/90) after initial period
- Avoid anticoagulation for nonvalvular atrial fibrillation
- Avoid heavy alcohol use
- No evidence regarding restrictions on statin use or strenuous activity

Rehabilitation and Recovery Recommendations
- Reasonable that all patients with ICH have multidisciplinary rehabilitation
- If possible, should be started as early as possible and continued through discharge and home care

Subarachnoid Hemorrhage

Key Reference

Prior guidelines issued 1994 and 2009
Current guidelines includes data through 2010

Workup recommendations
- Maintain high level of suspicion in patients with severe headache
- Noncontrast CT; if nondiagnostic, perform LP
- MRI adjunct imaging test; negative test still necessitates LP

Potentially devastating cause of intracranial bleeding
- Most caused by aneurysms
- 12-15% die before reaching hospital
- 6-10% of survivors functionally dependent
- Another 15% have significant lifestyle changes
Subarachnoid Hemorrhage

- Rebleeding associated with high mortality / poor prognosis
- Risk maximal first 2-12 hours
  - 4-13.6% rebleed in first 24 hours
  - One third of rebleeds occur in first 3 hours
  - Half within first 6 hours
  - Early rebleeding has poorer prognosis

Subarachnoid Hemorrhage

- Factors associated with rebleeding
  - Worse neuro status on admission
  - Longer time to aneurysm treatment
  - Initial loss of consciousness
  - Previous sentinel headaches
  - Larger aneurysm size
  - Possibly systolic blood pressure

Subarachnoid Hemorrhage

- For rebleed prevention
  - Control blood pressure ASAP with titratable agent
  - Magnitude of lowering unclear, but consider SBP < 160 mm Hg
  - If unavoidable delay of aneurysm obliteration (> 72 hrs), significant risk of rebleed and no contraindications, consider tranexamic acid or aminocaproic acid

Subarachnoid Hemorrhage

- Cerebral vasospasm after SAH common
  - Narrowing of visible cerebral arteries occurs 7-10 days after rupture
  - Resolves spontaneously within 21 days
  - Causes diffuse cerebral ischemia
    - A major cause of death and disability associated with SAH

Subarachnoid Hemorrhage

- Up to one quarter of SAH patients have seizures
  - Not clear they are all epileptic in origin
  - Delayed seizures in 3-7%
- Short term prophylaxis used
  - Based on concept that seizures could lead to additional injury / rebleed
  - Data weakly supportive of this practice

Subarachnoid Hemorrhage

- Oral nimodipine in all patients
  - Maintain euvoemia
    - Maintain normal circulating blood volume
    - CT or MRI useful to identify regions of potential brain ischemia
  - If DCI, consider inducing hypertension
Subarachnoid Hemorrhage
- Long term seizure treatment has not shown any significant effect on outcome
- Potential side effects do not appear to outweigh benefits

Subarachnoid Hemorrhage
- Seizure treatment
  - Consider prophylactic anticonvulsants in immediate post-hemorrhage period
  - Routine long term use not recommended
  - Special circumstances: Prior seizures, intracerebral hematoma, intractable hypertension, infarction, MCA aneurysm

Subarachnoid Hemorrhage
- Medical complications common
  - Electrolyte abnormalities
  - Fever
  - Hyperglycemia
  - Anemia
  - DVT

Subarachnoid Hemorrhage
- Electrolyte abnormalities
  - Hyponatremia
    - Seen in 10-30% of cases
    - Release of natriuretic peptides
    - "Cerebral salt wasting"
  - Recommendations
    - Avoid large volume hypotonic fluids
    - Avoid intravascular volume contraction
    - Monitor fluid status (central line)
    - Use crystalloid or colloid for volume contraction

Subarachnoid Hemorrhage
- Fever (central origin)
  - Independently associated with worse cognitive outcome
  - Control of fever may improve outcome
  - Recommendation
    - Aggressive control of fever
    - Target is normothermia
    - May need standard or advanced approaches

Subarachnoid Hemorrhage
- Elevated blood glucose
  - Relatively common
  - Associated with poor outcome
  - No proof aggressive glucose control improves outcomes
  - Hypoglycemia should be avoided

Hypoglycemia should be avoided
Subarachnoid Hemorrhage

- **Anemia**
  - Higher hemoglobin levels associated with improved outcomes
  - Optimal hemoglobin level unclear
  - Consider transfusing pRBCs in patients at risk for cerebral ischemia (larger bleeds, demonstrated spasm on imaging studies)

Subarachnoid Hemorrhage

- **Miscellaneous recommendations**
  - If < 10 SAH cases each year, transfer to institution with experience treating > 35 per year

Subarachnoid Hemorrhage

- **Summary**
  - **Workup recommendations**
    - Maintain high level of suspicion in patients with severe headache
    - Noncontrast CT; if nondiagnostic, perform LP
    - MRI adjunct imaging test; negative test still necessitates LP

Subarachnoid Hemorrhage

- **Summary**
  - **For rebleed prevention**
    - Control blood pressure ASAP with titratable agent
    - Magnitude of lowering unclear, but consider SBP < 160 mm Hg

Subarachnoid Hemorrhage

- **Summary**
  - **For vasospasm/diffuse cerebral ischemia**
    - Oral nimodipine in all patients
    - Maintain euvolemia
    - Maintain normal circulating blood volume
    - CT or MRI useful to identify regions of potential brain ischemia
    - If DCI, consider inducing hypertension

Subarachnoid Hemorrhage

- **Summary**
  - **Seizure treatment**
    - Consider prophylactic anticonvulsants in immediate post-hemorrhage period
    - Routine long term use not recommended
Subarachnoid Hemorrhage Summary

- Managing medical complications
  - Hyponatremia
  - Avoid large volume hypotonic fluids
  - Avoid intravascular volume contraction
  - Monitor fluid status (central line)
  - Use crystalloid or colloid for volume contraction

- Fever recommendation
  - Aggressive control of fever
  - Target is normothermia
  - May need standard or advanced approaches

- Hypoglycemia should be avoided
- Consider transfusing pRBCs in patients at risk for cerebral ischemia

If < 10 SAH cases each year, transfer to institution with experience treating > 35 per year

Thank You For Your Attention

Any Questions?