INTRACEREBRAL HEMORRHAGE

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INTRACRANIAL HEMORRHAGE
INTRACEREBRAL HEMORRHAGE

Definition: Spontaneous extravasation of blood into brain parenchyma that may extend into the ventricles or subarachnoid space.
Epidemiology

- Overall incidence 12-15 cases/100,000 population
- 10-15% strokes
- More common in elderly, African or Asian ethnicity
- Those receiving anticoagulation
- Mortality approaches 50% at 30 days
- <20% independent at 6 months
Causes

- **Primary**
  - HTN
  - CAA

- **Secondary**
  - Trauma
  - Hemor conv of stroke
  - AVM
  - Coagulopathy
  - Cerebral aneurysm
  - Neoplasm
  - Dural AV fistula
  - Cocaine
  - vasculitis
ICH in the young patient (age 15-45)

ICH in young

- Rp. AVM: 30%
- Undet.: 24%
- HTN: 15%
- Aneurym: 10%
- Drug Abuse: 7%
- Tumor: 4%
- Moyamoya: 2%
Amyloid Angiopathy

- Deposition of amyloid β peptide in small and medium sized blood vessels
- Results in fibrinoid necrosis and microaneurysm formation
- Prevalence increases with age from ~9% in age 60-69 to 58% in age >90
  - Lobar haemorrhages
  - Chances of rebleed: 21% in 2 yrs
Amyloid Angiopathy
Nonmodifiable Risk Factors

- Male gender
- Older age
- African or Asian ancestry
Modifiable Risk factors

- Hypertension
  - Most important risk factor
  - Uncontrolled HTN-risk doubles
  - Occurs mainly in deep structures-basal ganglia and thalamus, 30% lobar
Hypertensive Hemorrhage

- Accounts for 60-70% of ICH
- Theory:
  - Chronic hypertension causes degeneration, fragmentation and fibrinoid necrosis of small perforating arteries
  - Predisposes to rupture
Modifiable Risk Factors

- Warfarin- 5-10 fold increase
  - 15% ICH assoc with its use
- Alcohol- heavy acute use or chronic abuse
- Cocaine recreational
- Lower cholesterol-small increase risk
Pathophysiology
Hypertension-related neurological complications

- Cerebral thrombosis and embolism
- Intracerebral hemorrhage
- Rupture of microaneurysms
- Spontaneous
- Most frequent aneurysm locations

- Rupture of the vascular endothelium
- Circle of Willis
- Microaneurysm
CHARCOT-BOUCHARD ANEURYSMS

- Discrete arteriolar microaneurysms
- Most common in the distal portions of medium and small arterioles

BADJATIA AND ROSAND, INTRACEREBRAL HEMORRHAGE. THE NEUROLOGIST, VOL. 11, NO. 6: NOVEMBER 2005
Pathophysiology

- Complex Dynamic Process - 3 distinct phases
  1. Initial hemorrhage
  2. Hematoma expansion
  3. Perihematoma edema

Disease progression and outcome primarily effected by 2 and 3.
Pathophysiology

- Hematoma expansion occurs to some extent in most patients - can be signif.
- Important cause of early deterioration
- Exponential increase in mortality if hematoma > 30ml
<table>
<thead>
<tr>
<th>Study</th>
<th>Number of patients</th>
<th>Maximum time from symptom onset to baseline CT scan (h)</th>
<th>Time to second CT scan (h)</th>
<th>Definition of hematoma expansion</th>
<th>Patients exhibiting hematoma expansion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brott et al. (1997)²²</td>
<td>103</td>
<td>3</td>
<td>20</td>
<td>&gt;33% growth by second CT scan</td>
<td>38</td>
</tr>
<tr>
<td>Leira et al. (2004)₇³</td>
<td>266</td>
<td>12</td>
<td>48</td>
<td>&gt;33% growth by second CT scan</td>
<td>27</td>
</tr>
<tr>
<td>Mayer et al. (2005)²⁵*</td>
<td>120</td>
<td>3</td>
<td>24</td>
<td>&gt;33% growth by second CT scan</td>
<td>32</td>
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<tr>
<td>Lyden et al. (2007)³⁵*</td>
<td>288</td>
<td>6</td>
<td>72</td>
<td>&gt;33% growth by second CT scan</td>
<td>26</td>
</tr>
<tr>
<td>Anderson et al. (2008)²³*</td>
<td>200</td>
<td>6</td>
<td>24</td>
<td>&gt;33% growth by second CT scan or 12.5 ml total volume</td>
<td>23</td>
</tr>
<tr>
<td>Mayer et al. (2008)²⁴*</td>
<td>268</td>
<td>3</td>
<td>24</td>
<td>26%*</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

*Only the patients in the placebo or standard therapy arm of each trial are included here. *Value represents the mean percentage increase in hematoma volume between the first and second scans (the overall percentage of patients experiencing hematoma expansion was not reported).
Pathophysiology

- Perihematoma Edema
  - Develops early and evolves over days
  - Primary cause of neuro deterioration after 1\textsuperscript{st} day
  - Related to inflammatory and cytotoxic response
Clinical Presentation

- Rapid onset of focal neurological deficit
- Clinical signs of increased ICP
  - Change in consciousness
  - Headache
  - Vomiting
- Size and location of ICH
- Clinical deterioration occurs 30-50% pts usually within 1st 24 hrs
Clinical Presentation

- 76yo F presents to ER with sudden onset R sided weakness, aphasia, vomiting and diminished consciousness.
Diagnosis

- CT brain
  - Confirms diagnosis
  - Size, location
  - Mass effect, midline shift

- MRI brain
  - FU investigation to eval for AVM, tumor, etc

- Angiography
  - Aneurysm, AVM
Management

- ABC’s
- Many patients need mechanical ventilation
- BP control
- Manage increased intracranial pressure
Acute Management

- Hypertension
  - Excessive HTN cause of hematoma expansion and poor outcome
  - BP too low can cause decreased CPP
  - Targets remain controversial
  - Newer studies show improved outcomes with lower BP’s- INTERACT 1 and 2, ATACH
  - Baptist SBP < 160
Blood Pressure Control

- **AHA recommendation**
  - SBP>180 or MAP>130 - treat with infusion of labetalol, esmolol or nicardipine
  - Comatose patients - Monitor ICP and keep CPP 70-90mmHg
  - MAP should not be reduced beyond 15-30% over 1st 24 hrs because may exacerbate ischemia in area surrounding hematoma
the **Monro–Kellie doctrine**

- is that “the cranial cavity is a rigid sphere filled to capacity with noncompressible contents and that an increase in the volume of one of the constituents will lead to a **rise in intracranial pressure**”. 
Anticoagulation and ICH

- Most serious complication of warfarin
- Very high mortality - up to 67%
- No standardized guidelines for reversal of AC
  - Discontinuation of warfarin
  - Vitamin K
  - FFP
  - PCC
INR Reversal agents

- **Vitamin K**
  - Takes 6 hrs to reach levels, longer half life

- **FFP**
  - Contains multiple clotting factors
  - Effective in correcting INR acutely
  - Short DOA, large volumes

- **PCC (prothrombin complex concentrates)**
  - Multiple advantages over FFP
- PCC
  - Smaller volumes
  - No compatibility testing, no thawing
  - Corrects INR faster
  - Used more in Europe
Seizures and ICH

- Approx 8% patients will develop seizures within 30 days of ICH
- More likely to occur in lobar hemorrhages
- Use of anticonvulsants controversial but can reduce occurrence of early seizures
Nursing Considerations

- Bed elevation to 30 degrees
  - Lowers ICP, stable CPP
- Patient movement
  - Maintain body alignment with movement
- Endotracheal suctioning
  - Short and infrequent
- Bowel management
  - Prevent constipation which can inc ICP
Surgical Treatment for ICH

- 2 basic rationales:
  - Mechanical
    - Reduce mass effect, improve ICP and brain perfusion, prevent dangerous brain shifts and herniation
  - Chemical
    - Removal blood products to minimize secondary injury from biochemical or inflammatory processes
Easy decision
Cerebellar Hematomas

- >3cm benefit from surgery
- Can have abrupt and dramatic deterioration in 1st 24 hrs
- Signs of brainstem compression- CN 6/7 palsy
Surgical options for ICH

- Only stroke subtype that has defied attempts to find a scientifically proven effective therapy
- Metaanalysis has shown no benefit from surgical intervention
- STICH trial- important milestone in ICH surgical treatment
  - Goal was to investigate effectiveness of early surgery as compared to initial conservative management with later evacuation if deemed necessary by the neurosurgeon
STICH Trial

- Over 1000 patients
- Randomized to early surgical treatment (<96 hrs) vs medical management
- Conclusion - patients with spontaneous ICH show no benefit with surgery vs medical management
  - Subgroup of patients with superficial ICH showed some benefit
  - Enrolling for STICH II
MISTIE Trial

- Image guided catheter aspiration and delivery of tPA in ICH patients with volumes >20mL
- Early results favorable
- Limits destruction of normal brain tissue
Conclusion

- Optimism
- Further understand pathophysiology so we can find both better medical and surgical therapies.
- Improved surgical techniques with advanced technology using less invasive means of ICH removal
The End

Thank You!
The STICH results do not significantly change current practice.

- Patients with a subcortical or cerebellar hematoma at least 3 cm and impaired consciousness should be operated on.

- Comatose patients (GCS 8) with ICH in the basal ganglia or thalamus very unlikely benefit from clot removal.

- Minimally invasive methods may be useful if done early after ICH onset, but control of hemostasis may be difficult.
STICH Trial

- 902 ICH pts randomized trial of early hematoma evacuation (<96 hrs) vs medical
  - Excluded cerebellar ICH
- If ICH >1 cm from cortical surface, OR GCS ≤ 8
  - Surgical patients tended to do worse than medical
- If ICH < 1 cm from surface
  - Tended toward better outcomes with surgery, but not significant (OR 0.69, 95% CI 0.47-1.01)

STICH II- Trial Objectives

- To establish whether earlier surgical evacuation of lobar ICH will improve outcome compared initial conservative treatment.

- To better define the indications for early surgery.

- This will overcome two of the criticisms of STICH (timing was too late and sometimes location was too deep).
Clinical features

- Classic clinical presentation: Onset of sudden focal neurological deficit which progresses over minutes to hours
- 50% present with headache / vomiting
- LOC, Seizures
- May have onset after exertion or intense emotional activity
- More often during routine activity
- May occur during trauma
Treatments for reversing warfarin anticoagulation in patients with acute intracranial hemorrhage: a structured literature review

Brett F. Bechtel, Timothy C. Nunez, Jennifer A. Lyon, Bryan A. Cotton, and Tyler W. Berrett

Abstract

Study objective: The acute management of patients on warfarin with spontaneous or traumatic intracranial hemorrhage continues to be debated in the medical literature. The objective of this paper was to conduct a structured review of the medical literature and summarize the advantages and risks of the available treatment options for reversing warfarin anticoagulation in patients who present to the emergency department with acute intracranial hemorrhage.

Methods: A structured literature search and review of articles relevant to intracranial hemorrhage and warfarin and treatment in the emergency department was performed. Databases for PubMed, CINAHL, and Cochrane EBM Reviews were electronically searched using keywords covering the concepts of anticoagulation drugs, intracranial hemorrhage (ICH), and treatment. The results generated by the search were limited to English-language articles and reviewed for relevance to our topic. The multiple database searches revealed 586 papers for review for possible inclusion. The final consensus of our comprehensive search strategy was a total of 23 original studies for inclusion in our review.

Results: Warfarin not only increases the risk of but also the severity of ICH by causing hematoma expansion. Prothrombin complex concentrate is statistically significantly faster at correcting the INR compared to fresh frozen plasma transfusions. Recombinant factor VIIa appears to rapidly reverse warfarin’s effect on INR; however, this treatment is not FDA-approved and is associated with a 5% thromboembolic event rate. Slow intravenous dosing of vitamin K is recommended in patients with ICH. The 30-day risk for ischemic stroke after discontinuation of warfarin therapy was 3-5%. The risks of not reversing the anticoagulation in ICH generally outweigh the risk of thrombosis in the acute setting.

Conclusions: Increasing numbers of patients are on anticoagulation including warfarin. There is no uniform standard for reversing warfarin in intracranial hemorrhage. Intravenous vitamin K in addition to fresh frozen plasma or prothrombin complex concentrate is recommended be used to reverse warfarin-associated intracranial hemorrhage. No mortality benefit for one treatment regimen over another has been shown. Emergency physicians should know their hospital's available warfarin reversal options and be comfortable administering these treatments to critically ill patients.

Introduction

Outpatient prescriptions for warfarin increased 45% to 31 million in the United States during the period of 1998-2004 [1]. Warfarin usage will increase with the rising prevalence of diseases such as atrial fibrillation and the aging of the population [2]. There are more than 1 million emergency department (ED) visits annually for traumatic brain injury (TBI) in the US [3]. The use of warfarin increases a patient's risk for spontaneous intracranial hemorrhage and overall mortality. The incidence of spontaneous intracranial hemorrhage (ICH) is 7-10 times higher among patients taking warfarin compared to those not on anticoagulation [4]. Patients taking warfarin therapy account for 8-14% of all ICH [4,5], and ICH occurs 8-10 times more frequently in individuals on warfarin [4,6]. The annual risk of ICH in patients treated with
Stereotactic ICH Aspiration

- Many techniques
  - Ultrasonic aspiration
  - High pressure fluid irrigation
  - Endoscopic aspiration
  - Modified nucleotome
  - Catheter aspiration with injection of thrombolytic agent (UK or tPA)
Stereotactictic ICH Aspiration

- Potential advantages
  - Deep putaminal or thalamic haemorrhages may be accessible
  - Less damage to overlying brain
- 77% reduction in ICH volume at 48 hours, with no bleeding
  - Saline irrigation and aspiration after 1 mg rtPA q8h