Intracerebral Hemorrhage: an atypical presentation

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Intracerebral Hemorrhage (ICH)

- **Definition:**
- Brain Parenchymal blood collection secondary to local loss of vascular integrity
ICH on Gross Pathology

Coronal gross pathology from an elderly patient who died from spontaneous ICH secondary to amyloid angiopathy
Intracerebral Hemorrhage (ICH)

- **Epidemiology:**
  - Accounts for 10-15% of all strokes
  - Incidence 15 per 100,000
  - Highest mortality rate of all stroke subtypes
  - Median age of 56 years vs. ischemic stroke 65 years
Intracerebral Hemorrhage (ICH)

- **Primary ICH:**
  - 80% of all cases
  - Chronic hypertension
  - Amyloid angiopathy
Intracerebral Hemorrhage (ICH)

- **Secondary ICH:**
  - AV malformation
  - Intracranial neoplasm (primary or metastatic)
  - Cavernous angioma
  - Venous angioma
  - Cerebral venous thrombosis
  - Coagulaopathy (inherent/ drug)
  - Vasculitis
  - Cocaine/alcohol abuse
  - Conversion from ischemic stroke
Intracerebral Hemorrhage (ICH)

- **Clinical presentation:**
  - Acute focal neurologic deterioration; varies with clot size and location
  - 60% of patients have symptom progression
  - 40% of patients have maximal symptoms at onset

- **Symptoms:**
  - Headache (40%)
  - Vomiting (50%)
  - ↓ Consciousness (50%)
  - ↑ Blood pressure (90%)
  - Seizures (10%)
Intracerebral Hemorrhage (ICH)

Course of intracerebral hemorrhage: Schematic representation of rapid downhill course in terms of unusual behavior (green), hemimotor function (blue), and consciousness (red) in a patient with intracerebral (intraparenchymal) hemorrhage.
Intracerebral Hemorrhage (ICH)

- **CT Findings:**
  - Acute: Hyperdense mass
  - Isodense if Hgb <8-10 g/dl
  - Fluid-fluid levels with coagulopathy/thrombolytic therapy
  - Subacute: isodense mass (1-6 weeks)
  - Chronic: hypodense mass
# Intracerebral Hemorrhage (ICH)

<table>
<thead>
<tr>
<th>Location</th>
<th>Etiology</th>
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<tbody>
<tr>
<td>Putamen (28-42%)</td>
<td>HTN (90%)</td>
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<tr>
<td>Thalamus (10-26%)</td>
<td>HTN (90%)</td>
</tr>
<tr>
<td>Lobar (19-30%)</td>
<td>All other causes (65%) HTN (35%)</td>
</tr>
<tr>
<td>Cerebellum (8-15%)</td>
<td>HTN (85%)</td>
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<tr>
<td>Brainstem (4-11%)</td>
<td>HTN (85%)</td>
</tr>
</tbody>
</table>
Patient CF

- **History:**
  - 51 yo F with HTN, ovarian cysts, ↑ cholesterol
  - Had minor MVA 3 days prior, Ø LOC, Ø head injury
  - Resumed regular activities
  - C/o postero-lateral neck pain, worsening headache x 3 days
  - Was found unconscious in her house on day 3
  - Seizures x 2 PTA

- **Meds:**
  - lisinopril, OCP, lipitor
Our Pt CF: Head CT w/o Contrast

Intraparenchymal hemorrhage in Left temporal and parietal lobes

Mild shift of midline to right
Patients 1,2,3: Other Examples of ICH on CT

Note hyperdense intraparenchymal hemorrhage (black arrows) and midline deviation to the right (white arrow) in three different patients
Patients 4,5: More Examples of ICH on CT

Contrast enhanced CT showing ring enhancement with peripheral edema around resolving ICH.

Contrast enhanced CT showing minimal enhancement around sub-acute late ICH.
But, what if you see ICH on CT, MR, or angiography first?

What’s in your DDx?
ICH on CT, MR, or Angiography

- Common Differential Diagnoses:
  - Aneurysm (berry vs. infectious)
  - Arteriovenous malformation; venous angioma; cavernous angioma
  - Hemorrhagic venous infarction
  - Hypertension
  - Neoplasm
    - Primary: usually in white matter
    - Metastatic: usually in gray matter
  - Hemorrhagic arterial infarction
  - Trauma to head
ICH on CT, MR, or Angiography

- Uncommon Differential Diagnoses:
  - Amphetamine abuse
  - Amyloid angiopathy
  - Arteritis
  - Coagulopathy
  - Neonatal germinal matrix hemorrhage
  - Surgery; post-op
Anatomy Review: Venous Sinuses
Anatomy Review: Venous Drainage Territories

Yellow = Transverse Sinus
Red = Vein of Galen, Sigmoid sinus
Blue = Cavernous sinus
Green = Superior sagittal; sinus, cortical veins

Diagnostic Imaging: Brain, 1st ed, 2004
Our pt CF: Head CTA

- Ruled out aneurysm
- Ruled out arteriovenous malformation
- However…
Our pt CF: Head CT Angiogram

Focus on this area on the left and contrast to the right side.

- Internal Carotid artery
- Styloid process
- External carotid artery
- Internal Jugular Vein
Our pt CF: Head CT Angiogram

Note the filling defect in the internal jugular vein on the left
Our pt CF: Head CT Angiogram

Note the filling defect in the internal jugular vein on the left.
Our pt CF: Head CT Angiogram

Note the enhancement of the internal jugular vain as it enters the jugular foramen on the R side
Our pt CF: Head CT Angiogram

Note the enhancement of the transverse venous sinus on the R side only
## MR : Staging of ICH

<table>
<thead>
<tr>
<th>MR Findings</th>
<th>T1</th>
<th>T2</th>
<th>T2*</th>
<th>DWI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperacute</td>
<td>Isointense</td>
<td>Hyperintense</td>
<td>Hypointense</td>
<td>Hyperintense</td>
</tr>
<tr>
<td>Acute</td>
<td>Isointense</td>
<td>Hypointense</td>
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<tr>
<td>Subacute-early</td>
<td>Hyperintense</td>
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<tr>
<td>Subacute-late</td>
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<td>Chronic-early</td>
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Patients 6, 7: Examples of ICH on MR

Axial T1W MR shows hyperintense subacute-late intracerebral hematoma

Axial T2W MR of the same patient
Our pt CF: Coronal Head MR T1W w/ Contrast

Mixed hypointense, isointense signal within area of infarction. Note the abnormal signal intensity in the transverse venous sinus (empty delta sign)
Our pt CF: Axial Head MR T2W

Note the “heme-fluid layering” and the hyperintense peripheral edema
Our pt CF: Head MRA w/ Contrast

Confirmed the findings of CTA, ruled out aneurysm, AVM as a cause of ICH
Our Patient CF

- Likely Diagnosis:
  - Hemorrhagic venous infarction
Our Patient CF

- What could have caused the venous thrombosis?

- Very scarce articles in the literature describing internal jugular thrombosis with hemorrhagic infarction
Cerebral Venous Thrombosis

**Causes:**
- Acute dehydration (diarrhea)
- Chemotherapeutic agents (L-asparaginase)
- Cyanotic congenital heart disease
- Hypercoagulable states and coagulopathies (including OCP use, etc)
- Indwelling catheters
- Infections
- Malignancy
- Pregnancy
- Trauma
Internal Jugular Vein Thrombosis

**Causes:**

- Central venous or Swan-Ganz catheters in the IJ or subclavian vein
- IV drug abuse using the IJ vein for access
- Lemierre syndrome
- Deep neck infections
- Necrotizing soft tissue infections
- Following neck dissection as a complication
- Head and neck malignancy
- Distant malignancy producing hypercoagulable state
- Hypercoagulable state (factor V Leiden, protein C, protein S, or antithrombin III deficiency)
- Jugular bulb catheters
- After neck surgery involving prolonged retraction of the IJ vein
- Trauma
- Secondary to ovarian hyperstimulation syndrome
- As a complication of neck traction
- Association with ovulation induction with gonadotropins
- Spontaneous causes - Often secondary to undiagnosed malignancy or hypercoagulable state
Patient CF: Hospital Course

- Likely cause is still debatable, but trauma
- Work-up: hypercoagulable panel\(\oplus\) for low level of antithrombin III
- Patient was started on heparin with PTT goal of 40-60 and coumadin with INR goal of 2-3.
- On hospital day 9, CF was discharged. CF had fluent speech, but notable anomia, dyslexia, dyscalculia, and agraphestesia. Cranial nerve exam showed right visual field defect. Motor exam showed very mild right hemiparesis.
Summary

- ICH represents 10-15% of all strokes
- HTN accounts for 80% of all cases
- CT is the gold standard in the initial work-up
- CT findings according to time of ICH: hyperdense $\rightarrow$ isodense $\rightarrow$ hypodense
- MR: staging based on T1, T2 and for further work-up
References

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