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UNC School of Medicine
July 2018
65-year-old woman presents with the worst headache of her life
HPI:
65yoF w/ PMH of HTN and atrial fibrillation (on apixiban).
Pt was resting at home when she experienced sudden onset excruciating headache with associated blurry vision and nausea.
She reports no vomiting, confusion, lethargy.

Physical Exam:
All exam components, including neurologic exam, within normal limits:
Eyes open spontaneously, Oriented to name, location, time, Pupils equal and reactive bilaterally,
Extraocular movements intact bilaterally, Facial sensation intact V1-V3 bilaterally, Face symmetric,
Tongue protrudes in the midline, Full shrug bilaterally, Motor strength 5/5 x 4, No pronator drift,
Absent Hoffman sign bilaterally, Absent ankle clonus bilaterally, Sensation to light touch intact throughout
List of imaging studies

- CT head w/o contrast
- CTA
- IR angiogram
CT head without contrast (axial and sagittal)

Findings?
Hyperattenuating material is seen filling the subarachnoid space.

Most likely etiology?
Hyperattenuating material is seen filling the subarachnoid space. Most likely etiology?

Diffuse subarachnoid hemorrhage through the interhemispheric fissures, bilateral sylvian fissures, ambient cisterns, left frontotemporal sulcus, and small volume layering intraventricular blood at the occipital horns of the lateral ventricles. Mildly prominent third ventricle and temporal horns of lateral ventricle. There is no midline shift or mass lesion. There is no evidence of acute infarct. No fractures are evident. The sinuses are pneumatized. Mastoid air cells are clear.
CT Angiogram

Multilobulated aneurysm located off of the pericallosal artery
IR cerebral angiogram (with 3-D rotational angiogram)
Left internal carotid artery injection demonstrates opacification of the left middle and anterior cerebral arteries. There is opacification of the left posterior cerebral artery and flash filling of the basilar artery with its branches through the posterior communicating artery. Again demonstrated is an azygos A2 segment. There is a small irregular aneurysm arising from what appears to be a left pericallosal artery arising from the common A2 segment. The aneurysm is directed superiorly just distal to the origin of the A3 segment.
From Op Note for right frontal craniectomy for clipping of pericallosal aneurysm

- It was decided that surgical clipping may be the best therapeutic option considering the small size of the aneurysm and the relatively wide neck.
- Upon approaching the aneurysm we then dissected posteriorly to find the distal A3 vessels thought to be arising from the aneurysm and utilized this to orient ourselves anatomically towards the aneurysm. We then focused our dissection inferior and anterior to reach the proximal A3 vessel. During this portion we first noted a small amount of arterial bleeding followed by a brisk rush of blood revealing an intraoperative rupture. The patient was placed in burst suppression and the bleeding was quickly stopped over approximately several minutes with modest blood loss and the use of temporary clips. No change was observed in neurophysiologic monitoring during this time period. We then focused on further revealing the aneurysm which appeared multiolbular/fusiform in appearance. We placed three small mini clips along the origin of the aneurysm taking care to preserve a small callosal marginal branch arising at the base of the aneurysm. The temporary clips were then removed. Intraoperative ICG was then performed which demonstrated good flow into the parent vessels without flow into the aneurysm.
Pt underwent right frontal craniectomy for clipping of pericallosal aneurysm
- Intraoperative rupture controlled
- Monitored in NSICU
- Discharged 10 days after presentation
Interval clipping of previously seen pericallosal artery aneurysm, with a small residual neck remnant.
10% of hemorrhagic strokes
~50% fatality rate
Typically occurs in the setting of trauma or ruptured aneurysm

Clinical Presentation
- 97% experience sudden, severe headache
- AMS, vomiting
- Preretinal subhyaloid hemorrhages
  => Terson Syndrome
- Lack of lateralizing neurologic signs

A thunderclap headache (TCH) is a very severe headache of abrupt onset that reaches its maximum intensity within one minute or less of onset.
ACR Appropriateness Criteria for initial diagnosis:\textsuperscript{1}
- CT head non-contrast
- Brain MRI
- Lumbar Puncture\textsuperscript{2}

\textbf{Clinical Condition:} Headache

\textbf{Variant 3:} Sudden onset of severe headache ("Worst headache of my life", "thunderclap headache").

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT head without IV contrast</td>
<td>9</td>
<td></td>
<td>⚫⚫⚫⚫</td>
</tr>
<tr>
<td>CTA head with IV contrast</td>
<td>8</td>
<td></td>
<td>⚫⚫⚫⚫</td>
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<tr>
<td>MRA head without and with IV contrast</td>
<td>7</td>
<td></td>
<td>O</td>
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<tr>
<td>Arteriography cervicocerebral</td>
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<td>7</td>
<td>depending on CT findings. Include FLAIR and GRE or SWI in this procedure.</td>
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<tr>
<td>MRI head without and with IV contrast</td>
<td>6</td>
<td>Include FLAIR and GRE or SWI in this procedure. This procedure may be helpful after CT depending on CT findings.</td>
<td>O</td>
</tr>
<tr>
<td>CT head without and with IV contrast</td>
<td>5</td>
<td></td>
<td>⚫⚫⚫⚫</td>
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<tr>
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<td>3</td>
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\textbf{Rating Scale:} 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

\textbf{CT sensitivity in the first 6 hours after onset of headache is nearly 100%!}\textsuperscript{7}
The sensitivity of head CT for detecting SAH is highest in the first 6 to 12 hours after SAH (nearly 100 percent) and then progressively declines over time to about 58 percent at day five. FLAIR and T₂ sequences on MRI may have comparable sensitivity to CT. Additionally, they have a high sensitivity in patients with a subacute presentation of SAH (e.g., >4 days from the bleed).

Failure to obtain a head CT scan at initial contact was the most common error, occurring in 73 percent of misdiagnosed patients.

You MUST do lumbar puncture if there is suspicion for SAH despite normal head CT. Classic findings of SAH are elevated opening pressure and elevated red blood cell count that does not decrease from CSF tube one to tube four (one study proposed 63% reduction--Czuczman).
Discussion

- Determining cause
  - Digital subtraction angiography is the gold standard
  - CTA
  - MRA

- Grading severity
  - Hunt and Hess grade – based on neurologic status
  - Fisher grade – based on CT findings

Hunt and Hess grading system for patients with subarachnoid hemorrhage

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<td>2</td>
<td>Severe headache, stiff neck, no neurologic deficit except cranial nerve palsy</td>
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Fisher grade of cerebral vasospasm risk in subarachnoid hemorrhage

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A system proposed by Ogilvy and Carter stratifies patients based upon age, Hunt and Hess grade, Fisher grade, and aneurysm size. In addition to predicting outcome (~80% had good to excellent outcomes in grades 0 to 2), this scale more accurately substratifies patients for therapy.

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Treatment$^{3,4,6}$

- Microsurgical clipping or endovascular coil is equally effective
- Complication Prophylaxis
  - Rebleeding
  - Vasospasm
    - Serial transcranial dopplers
    - Nimodipine x 3 weeks
  - Hydrocephalus
  - Hyponatremia 2/2 to SIADH or cerebral salt wasting
  - Seizures
Treatment

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Complication Prophylaxis

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Sodium levels should be checked daily (goal >135)
Goal SBP <160 until aneurysm secured, <180 after securing – permissive hypertension to prevent ischemia (While lowering blood pressure may decrease the risk of rebleeding in a patient with an unsecured aneurysm, this benefit may be offset by an increased risk of infarction)
Keppra 500 BID until aneurysm secured and x7 days post op
1mSv = 4 months background radiation
~12-15mSv and about that much in thousands of dollars, but all pales in comparison to the total 40,000-185,000 for brain aneurysm repair

**Discussion**

- **Imaging Costs**:\(^{1,10}\)
  - 3 CTs – 1-10 mSv × 3 / $600 each
  - 1 CTA – 1-10 mSv / $1500
  - 1 IR angiogram – 1-10 mSv / $7,600
  - Intraop fluoro – 1-10 mSv / ??
  - 1 CXR – 0.1 mSv / $70
  - 1 Abd XR – 0.1 mSv / $60
  - 1 Echo – omSV / $600
  - 5 transcranial dopplers – omSV / $180 each
Traumatic subdural hematoma (SDH) with small right frontal subarachnoid hemorrhage – note difference in distribution compared to aneurysm-related SAH
Companion Cases: Pseudo-SAH\textsuperscript{8,9}

- Pseudo-SAH is usually due to cerebral edema due to hypoxic ischemic brain injury
References

8. Case courtesy of Dr David Holcroft, Radiopaedia.org, rID: 44918
9. Case courtesy of Dr Andrew Dixon, Radiopaedia.org, rID: 9345