Internal Carotid Artery Dissection

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Agenda

• Presentation of a clinical case
• Discussion of the clinical features of ICA dissection
• Discussion of the imaging modalities used to diagnose ICA dissection
Our Patient

- 29M with sudden onset of severe right-sided headache associated with exertion
- Pt called his primary care doctor who sent him to the emergency department for evaluation
- Normal neurological exam with no focal findings
- Non-contrast head CT and CT angiogram were performed to rule out subarachnoid hemorrhage
Our Patient: Non-Contrast Head CT

Final read: negative for acute intracranial process

Non-contrast head CT
Image from PACS, BIDMC
Our Patient: CTA

Right ICA with slightly narrowed lumen

Left ICA with normal lumen
Our Patient:
Pseudoaneurysm on CTA

Pseudoaneurysm

Right ICA

CTA
Images from PACS, BIDMC
Our Patient: Narrowed Carotid on CTA

Narrowed lumen
Intramural hematoma
Pseudoaneurysm
Right ICA

CTA Images from PACS, BIDMC
Our Patient: CTA Reconstruction

CTA reconstruction
Image from PACS, BIDMC
Clinical Features of ICA Dissection

- Tends to occur in young and middle-aged adults
- Unilateral pain in head, face, or neck
- Unilateral Horner’s syndrome (oculosympathetic palsy: miosis and ptosis)
- Cerebral or retinal ischemia
- Cranial nerve palsies (in ~12% of pts)
- Pulsatile tinnitus
- Objective bruit
- Due to its diversity of clinical features, imaging plays a key role in diagnosis!

Rodallec et al. 2008
Schievink 2001
Pathophysiology

- Usually arises from an intimal tear
- Intramural hematoma forms, compressing lumen
- Subintimal dissection leads to lumen stenosis
- Subadventitial dissection leads to pseudoaneurysm formation

Schievink 2001
Image from www.nature.com
Pathogenesis - Genetic Factors

• Underlying structural defect of the arterial wall
  * Identified in only 1-5% of pts with spontaneous ICA or vertebral dissection
    – Ehlers-Danlos Syndrome (particularly Type IV)
    – Marfan’s Syndrome
    – Autosomal Dominant Polycystic Kidney Disease
    – Osteogenesis Imperfecta Type I

• 15% of pts with spontaneous dissection have evidence of fibromuscular dysplasia

Schievink 2001
Pathogenesis - Environmental Factors

• History of a minor precipitating trauma
  – Yoga
  – Painting a ceiling
  – Coughing, vomiting, sneezing
  – Undergoing anesthesia
• Chiropractic manipulation
  – ~ 1 in 20,000 causes a stroke
• Seasonal variation (most present in the fall)
  – Possibly an infectious trigger?
• Atherosclerosis is *uncommon* in pts with dissection

Schievink 2001
Differential Diagnosis

- Fibromuscular dysplasia
- Dysgenesis of the ICA
- Other causes of arterial thickening:
  - Atherosclerosis
  - History of radiation treatment
  - Takayasu arteritis
  - Bechet’s disease
  - Giant cell arteritis

Rodallec et al. 2008
Treatment

- To prevent thromboembolic complications:
  - Anticoagulate with IV heparin
  - Bridge to oral warfarin, INR 2.0-3.0 for 3-6 months
- Contraindications:
  - Intracranial hemorrhage
  - Intracranial extension of the dissection
- No randomized controlled trials have proven the effectiveness of anticoagulation
  - However, imaging suggests ~90% of infarcts secondary to dissection are thromboembolic rather than hemodynamic in origin

Schievink 2001
Kistler et al. 2011
Imaging in ICA Dissection

• ACR Appropriateness criteria for:
  – Sudden onset severe headache
  – Suspected ICA dissection

• Findings on various imaging modalities:
  – Ultrasound (US)
  – Computed tomography angiography (CTA)
  – Magnetic resonance (MR)
  – Conventional angiography
# Imaging for Sudden-Onset Severe Headache

**Variant 3:** Sudden onset of severe headache ("Worst headache of one’s life", "thunderclap headache").

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
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<tbody>
<tr>
<td>CT head without contrast</td>
<td>9</td>
<td></td>
<td></td>
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<tr>
<td>CTA head with contrast</td>
<td>8</td>
<td>Usage of CT vs MRI depends on local preference and availability.</td>
<td></td>
</tr>
<tr>
<td>MRA head with or without contrast</td>
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<td>Usage of CT vs MRI depends on local preference and availability. See statement regarding contrast in text under &quot;Anticipated Exceptions.&quot;</td>
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<td>Arteriography cervicocerebral</td>
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<tr>
<td>MRI head without contrast</td>
<td>7</td>
<td>May be helpful after CT depending on CT findings.</td>
<td>O</td>
</tr>
<tr>
<td>MRI head without and with contrast</td>
<td>6</td>
<td>May be helpful after CT depending on CT findings. See statement regarding contrast in text under &quot;Anticipated Exceptions.&quot;</td>
<td>O</td>
</tr>
<tr>
<td>CT head without and with contrast</td>
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</table>

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
# Imaging for Suspected ICA Dissection

## Variant 4: Sudden onset of unilateral headache, or suspected carotid or vertebral dissection or ipsilateral Horner’s syndrome.

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
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<th>RRL*</th>
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<td>CTA head and neck with contrast</td>
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<td>Usage of CT versus MRI depends on local preference and availability.</td>
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<td>MRI head without and with contrast</td>
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<td>With diffusion-weighted sequences. See statement regarding contrast in text under “Anticipated Exceptions.”</td>
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<tr>
<td>MRI head without contrast</td>
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<td>With diffusion-weighted sequences.</td>
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<tr>
<td>CT head without contrast</td>
<td>7</td>
<td></td>
<td>⬤ ⬤ ⬤</td>
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<td>Arteriography cervicocerebral</td>
<td>7</td>
<td></td>
<td>⬤ ⬤ ⬤</td>
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<td>CT head without and with contrast</td>
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<td>US carotid duplex</td>
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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
ICA Dissection on US

- Possible findings include:
  - Mural hematoma and/or thrombus (thickened hypoechoic vessel wall)
  - Stenosis or occlusion

- Drawbacks:
  - Sensitivity decreases as the extent of stenosis decreases
  - Does not detect most pseudoaneurysms

Rodallec et al. 2008
US, image from Rodallec et al. 2008
ICA Dissection on CTA

• Possible findings:
  – Narrow eccentric lumen with increased external diameter of the artery
  – Crescent-shaped region isoattenuating to surrounding muscles
  – Intimal flap
  – Pseudoaneurysm

• Drawbacks:
  – Bone artifacts at skull base
  – Dental artifacts

Rodallec et al. 2008
Companion Patient #1: Bilateral ICA Dissection on CTA

47M with L hand weakness

CTA Images from PACS, BIDMC
Companion Patient #2: ICA Dissection on MR

- Possible findings:
  - Narrowed eccentric flow void
  - Crescent-shaped subacute intramural hematoma

- Compared to conventional angiography:
  - 84% sensitive
  - 99% specific

Rodallec et al. 2008
MR, image from PACS, BIDMC

55M with TIA:

Axial T1 MR with fat saturation
ICA Dissection on Conventional Angiography

• The gold standard imaging modality
• **String sign**: long, tapered, eccentric and irregular stenosis that begins distal to the carotid bulb
• **String and pearl sign**: focal narrowing with a distal site of dilatation

Rodallec et al. 2008
Angiography, image from www.medscape.com
Summary

• Suspect ICA dissection in young patients who present with sudden onset headache

• Imaging modalities used to diagnose ICA dissection include:
  – US: thickened hypoechoic vessel wall
  – CTA: narrow eccentric lumen with increased external diameter of the artery
  – MR: narrowed eccentric flow void with crescent-shaped subacute intramural hematoma
  – Conventional angiography: string sign

• Treatment: anticoagulation
Outcome For Our Patient

• Diagnosed with right ICA dissection
• Admitted to neurology
  – Started on heparin
  – Discharged on enoxaparin and warfarin
  – Plan for repeat CTA and neurology follow-up in 3 months
Outcome For Our Patient, cont.

- Several days after discharge, presented to ED with left arm weakness
- CTA at that time showed decrease in size of right ICA lumen and increase in size of pseudoaneurysm
- INR found to be sub-therapeutic
- MR showed no acute cerebral infarct
- Admitted to neurology given concern for TIAs secondary to ICA dissection
  - Started on heparin
  - Discharged on increased dose of warfarin
Acknowledgments

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• Michael April, HMS IV
• Emily Hanson
References

• Expert Panel on Neurologic Imaging. ACR Appropriateness Criteria: Headache. acsearch.acr.org
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