Cavernous Sinus Thrombosis

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Agenda

• Patient presentation
• Relevant anatomy
• Differential diagnosis
• Menu of radiologic tests
• Radiologic imaging

• Cavernous sinus thrombosis
  – Classic signs and symptoms
  – Pathogenesis
• Case resolution
• Companion cases
Objectives

1. Learn the clinical presentation and differential diagnosis for cavernous sinus thrombosis
2. Understand the menu of radiologic tests available
3. Review orbital anatomy
Our Patient: HPI

- 18 year old woman presented to university health center with fever, headache, cough, neck lymphadenopathy
  - Diagnosed with “infectious mononucleosis”
- Several days later, she became lethargic and started to have rigors, admitted to OSH
- At OSH, WBC: 17.7 (4% bands), creatinine: 2.5, BP: 80/40's, and GNR in blood
- Antibiotics were initiated
- The following morning, awoke with right facial numbness, double vision, and inability to open right eye
- She was transferred to BIDMC for further care
Our Patient: Medical History

- PMH: No medical history or hospitalizations
- Allergies: NKDA
- Medications: Ibuprofen as needed, no OCP
- Social Hx: College student, lives in the dorm; denies smoking, alcohol or illicit drug use.
- Family Hx: No history of strokes or hypercoagulability
Our Patient: Physical Exam

- Gen: Lying in bed, fatigued, NAD
- HEENT: NC/AT, moist oral mucosa
- Neck: Supple, no tenderness to palpation, normal ROM, no carotid or vertebral bruit; neck lymphadenopathy
- Back: No focal tenderness or erythema
- CV: RRR, normal S1 and S2, no murmurs/gallops/rubs
- Lung: Clear to auscultation bilaterally
- Abd: Soft, nontender, nondistended, normoactive bowel sounds
- Ext: No edema
Our Patient: Neurologic Exam

• Neuro:
  – Left cranial nerves II-XII intact
  – Right eye papilledema, blurred disc margin
  – Right pupil 6 mm sluggish, cannot adduct or move eye superiorly or inferiorly
  – Right eye ptosis
  – Pain with eye movements
  – Diminished sensation in V1 and V2, sensation normal in V3 on right
  – Sensation, strength, reflexes, coordination normal
It appears that multiple cranial nerves are involved. Can we localize these abnormalities to one lesion in the brain?

Let’s review the relevant anatomy.
Orbital Apex Anatomy

Drake, et al, Fig 8.83
Muscles at the Orbital Apex

Drake, et al, Fig 8.90
Let’s review some anatomy on this coronal C+ CT at the level of the orbits.

**CNII (optic nerve)**

**CNIII (oculomotor)**
- Medial rectus
- Superior rectus
- Inferior rectus

**CNIV (trochlear)**
- Superior oblique

**CNVI (abducens)**
- Lateral rectus

**Superior ophthalmic vein**
Orbital Venous Drainage

Drake, et al, Fig 8.93
Venous Drainage of the Skull

Drake, et al, Fig 8.43
Cavernous Sinus Anatomy

The cavernous sinus extends from the superior orbital fissure to the petrous portion of temporal bone.

Cavernous sinus blood supply arises from the superior ophthalmic veins, cerebral veins, sphenoparietal sinuses, deep facial muscles, and inferior ophthalmic veins.

Drake, et al, Fig 8.44
With a better understanding of the orbital and cavernous sinus anatomy, we can now form a differential diagnosis for our patient’s ophthalmoplegia and cranial nerve findings.
Differential Diagnosis: Acute Painful Ophthalmoplegia

- **Cavernous sinus thrombosis** (CN III, IV, VI, V1-V2, superior ophthalmic vein)

- **Orbital apex syndrome** *(superior orbital fissure: CN III, IV, VI, V1, superior ophthalmic vein; optic canal: ophthalmic artery and optic nerve)*, our patient did not have impaired vision

- **Superior orbital fissure syndrome** (CN III, IV, VI, V1), our patient had V2 involvement

- Orbital cellulitis (periorbital swelling, proptosis, chemosis, ophthalmoplegia, fever, decreased vision, pain)

- Preseptal cellulitis (no proptosis or ophthalmoplegia)
Differential Diagnosis: Chronic Painful Ophthalmoplegia

- Local malignancy, metastasis
- Aseptic thrombus from trauma, myeloproliferative diseases, dehydration
- Granulomatous diseases (TB or fungal, sarcoid, syphilis, Tolosa-Hunt syndrome)
- Aneurysm of internal carotid artery
- Carotid-cavernous fistula
- Endocrine exophthalmos
- Ophthalmoplegic migraine

Given that our patient had acute onset of cranial nerve III, IV, VI, VI and V2 involvement, cavernous sinus thrombosis is the most likely diagnosis. Let’s look at the menu of radiologic tests available for further evaluation.
Cavernous Sinus Thrombosis: Menu of Radiologic Tests

- MRI with and without contrast, MRV
  - Sensitive for detection of venous thrombus
- CT with and without contrast
  - Usually the first study, may be normal in 30%
- Before CT or MRI were available:
  - Clinical diagnosis or found at autopsy
  - Cerebral angiography or orbital venography
    - Difficult to puncture facial veins with edema
    - Also risky to inject contrast under pressure (disseminated infection, extension of thrombus)

Our Patient: Cavernous Sinus Thrombosis on Coronal MRI

Coronal C-T1 weighted MRI at the level of the cavernous sinus

Thickening of the right cavernous sinus (arrow) compared with the left
Our Patient: Cavernous Sinus Thrombosis on Axial MRI

Axial C- T1 weighted MRI at the level of the orbits

Thickening of the right cavernous sinus (arrow)
Our Patient: Cavernous Sinus Thrombosis on MRA

Three-dimensional time-of-flight MR arteriography

Right carotid artery (arrow) remains patent throughout its course through the cavernous sinus
Our Patient: Cavernous Sinus Thrombosis on Axial CT

The following day

Axial C+ CT at the level of the orbits

Mild enlargement of superior ophthalmic vein (arrow)

Low attenuation region in the right cavernous sinus (arrow) representing thrombus
Our Patient: Cavernous Sinus Thrombosis on Coronal CT

Coronal C+ CT at the level of the cavernous sinus

Areas of low attenuation within the cavernous sinus (arrow) also visible on this view
Our Patient: Cavernous Sinus Thrombosis, Six Days Later

*Six days after presentation*

Coronal contrast enhanced T1 weighted MRI with fat suppression at the level of the cavernous sinus

Right internal carotid narrowing (arrow) compared with left

Meningeal thickening (arrow) along inferior aspect of temporal lobe consistent with meningitis
Our Patient: Cavernous Sinus Thrombosis, Twelve Days Later

Twelve days after presentation

Right ICA narrowing (arrows) secondary to inflammatory changes along the wall

Coronal C+ T1 weighted MRI

MRA
Our Patient: Cavernous sinus thrombosis, MRA Comparison

Absent flow through the right ICA compared with MRA at presentation (arrows).

On the day of presentation

Twelve days after presentation
### Cavernous Sinus Thrombosis: Classic Signs and Symptoms

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<tr>
<td>Fever</td>
<td>Chemosis</td>
<td>80-100%</td>
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<td>Ptosis</td>
<td>Cranial nerve palsies</td>
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<td>Proptosis</td>
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<td>Lethargy</td>
<td>Papilledema</td>
<td>50-80%</td>
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<td>Headache</td>
<td>Venous engorgement</td>
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<td>Periorbital swelling</td>
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<td>Decreased visual acuity</td>
<td>Decreased corneal reflex</td>
<td>&lt; 50%</td>
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<td>Sluggish or dilated pupil</td>
<td>Nuchal rigidity</td>
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<td>Periorbital sensory loss</td>
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<tr>
<td>Diplopia</td>
<td>Hemiparesis</td>
<td>&lt; 20%</td>
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<td>Seizures</td>
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Southwick FS, et al 1986
Cavernous Sinus Thrombosis: Pathogenesis

- Dural sinuses are valveless, susceptible to infection from multiple sites (sphenoids and ethmoids most common, also face, tonsils, soft palate, teeth, ears)
- Enlarging infected clots can spread and involve both sides
- Can result in sepsis, meningitis, subdural empyema, pituitary necrosis

Our patient: Case Resolution

- Patient ultimately found to have dental infection as source.
- Her course was complicated by septic shock, acute renal failure, DIC, septic pulmonary embolism, and respiratory failure necessitating intubation.
- She eventually stabilized and was discharged on anticoagulation and antibiotics.
- Resolution of most cranial nerve symptoms with moderately decreased sensation in V1-V2
Let’s view some companion cases of cavernous sinus thrombosis to further highlight the classic findings on radiologic imaging.
CST: Companion Case 1

Periorbital swelling, erythema, proptosis, chemosis (conjunctival edema)

Enlarged superior orbital vein (arrows)

Axial (C) and coronal (E) C+ CT

Upper lid and periorbital edema, ptosis, chemosis, and conjunctival injection

Small collections of gas in both superior ophthalmic veins, the right cavernous sinus and the right upper lid soft tissue (arrows)

CT C+ axial slice through orbits

CST: Companion Case 3

T1 with contrast showing multiple irregular defects within the enhancing cavernous sinus on the left side (arrowheads).

Yoshida T, et al. 2008
Enhanced axial CT scan showing engorgement of left superior orbital vein with filling defect within it (arrow), with resultant proptosis of the left eye.
References

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