Radiological Imaging of the Visual Pathways: A Patient with a Planum Sphenoidale Meningioma

Descartes, 1604


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Agenda

1. Case Presentation of Patient RR
2. Anatomy of the Visual Pathways
3. Menu of Tests for Imaging of the Visual Pathways
4. Review of Patient RR’s Imaging Studies
5. Discussion of Findings
Patient RR: Presentation

History:
75 year-old woman who noticed progressive decreased vision in her left eye starting ~2 years ago with no visual changes in right eye
- PMH: Hypertension
- Ocular history: unremarkable

Exam: 20/25 OD
20/400+1 OS no improvement w/pinhole
Color vision 16.5/17 OD, unable to see plates OS
Relative afferent pupillary defect OS
No other focal neurological deficits

Next step: Direct visualization of the retina and optic nerve head
Clinical Features of Optic Nerve Disease:

1. Afferent pupillary defect ✓
2. Optic disc changes ✓
3. Poor color vision ?
4. Field loss ?

Patient RR has 2 features suggestive of optic nerve disease (color vision unable to be assessed to do poor vision and field loss not formally evaluated)
Anatomy of the Visual Pathways

• Visual information processed by rods and cones of retina

• Transmitted via optic nerves (CNII)

• Nasal fibers cross at the optic chiasm

• Fibers synapse at the lateral geniculate nucleus

• Geniculocalcarine tract forms the optic radiation that fans into optic radiations to occipital cortex

Lesions here cause: Bilateral field defects*

Lesions here cause: Unilateral field defects

*Exception: temporal 60-90 degrees of vision (temporal crescent) has monocular representation in the most anterior part of the striate cortex.
Differential Diagnosis of Unilateral Optic Neuropathy

Inflammation/Infection
- Idiopathic demyelinating optic neuritis

Vascular (infarction)
- Anterior ischemic optic neuropathy
- Posterior ischemic optic neuropathy

Trauma
- Isolated optic nerve trauma is possible, but very unlikely

Tumor
- Optic nerve compression
  - Intracranial meningiomas, primary optic nerve sheath tumors
- Optic nerve infiltration
  - Leukemia, lymphoma or disseminated carcinoma
- Chiasmal compression
  - Pituitary tumors, craniopharyngioma

Next: Review the Menu of Tests for Imaging the Visual Pathways
Menu of Tests for Imaging of the Visual Pathways

CT
+ better for osseous detail of orbits and calcifications
+ better for assessing orbital fractures

MRI
+ better for imaging optic nerve and tumors
+ better for evaluation of cerebral perfusion and post-chiasmal lesions

http://www.djo.harvard.edu/files/2918_349.jpg

T1 PACS, BIDMC, 2007

Globe
Maxillary sinus
Orbital Floor
Inferior Turbinates

DJO
Menu of Tests for Imaging of the Visual Pathways

**Ultrasound**
+ used for imaging globe when no view to posterior pole
+ used for imaging of foreign bodies in the orbit
-poor penetration and resolution

**Angiography**
+ used to assess for vascular malformations, stenosis or vascularized tumors
-invasive

- **Detached Retina**
  
  [Image: www.ophthalmicultrasonography.com/CD%20BScan.htm]

- **Angiography**
  
  [Image: www.urmc.rochester.edu/smd/Rad/diagneuro.htm]
MRI Imaging of the Visual Pathways

1. Optic canal
2. Globe
3. Dorsum sellae
4. Sphenoid sinus
5. Macula
6. Medial rectus muscle
7. Lateral rectus muscle
8. Optic nerve
9. Ophthalmic artery
10. Temporal lobe

T2 with Fat Saturation – improved visualization of optic nerves

T2 MRI Imaging of the Visual Pathways

Optic nerve
Amygdolo-claustral area
Optic tract
Archcortex
Optic tract
Archcortex
Optic radiation

Requisition: “loss of vision left eye”

“No evidence of acute infarct, mass effect, or hydrocephalus.”

“No evidence of vascular occlusion or stenosis”

Next: Further Testing for Evaluation of Vision Loss
Further Testing: Visual Fields and Optical Coherence Tomography (OCT)

- Significant superior and temporal field loss OS

- Optical coherence tomography (OCT) of the optic nerves demonstrated definite nerve fiber layer losses OS and questionable thinning of optic nerve OD

- Findings suggestive of “compressive lesion” by neuro-ophthalmologist despite initial negative imaging

Next: Further Imaging of the Visual Pathways in Patient RR
Patient RR: C+ MRI of Orbit and Head 12/2007

Enhancing lesion w/ well-circumscribed margins
DDx: meningioma, pituitary macroadenoma, hemangiopericytoma
Planum Sphenoidale Meningioma

- Meningioma of the dura of the planum sphenoidale: lying on the midline posterior to the olfactory nerve meningiomas and anterior to the tuberculum sella meningiomas
- Planum sphenoidale forms the roof of the sigmoid sinus
- Peak incidence at age 45, 2:1 female
- Isointense or hypointense on T1 MRI, intense enhancement w/ contrast
- Small lesions and those isointense may be difficult to pick up on MRI
- Focal areas of nonenhancement within the tumors may be present representing areas of hemorrhage, scar, cyst, or necrosis.
Was the lesion missed in the original head MRI?

Patient RR: T2 Head MRI 6/2007

Incorrect imaging study was ordered for “Vision loss left eye”.

Orbital cuts and contrast enhanced images not evaluated.

Lesion evident on original MRI, but did not enhance without contrast
Treatment of Planum Sphenoidale Meningioma

**Surgical resection**
- Transphenoidal or transcranial approaches
- 10-40% have worsening of vision
- 25-80% have improvement in visual function

**Radiation therapy**
- May halt growth of tumor
- Less ideal than surgery because radiation does not remove pressure on optic nerve or chiasm
- Proton beam radiotherapy – less scatter
- Cyberknife

**No treatment – follow with imaging**
- Not recommended given visual deficit, but Patient RR opted for no intervention
Role of Imaging in Following Tumor

Patient RR: C+ T1 Head MRI 9/2008

Tumor unchanged in volume by MRI, but increased visual field loss in superotemporal right eye

Courtesy of Nurhan Torun, M.D., 2008

BIDMC, PACS, 2008

OS

OD

9/2007

5/2008

Courtesy of Nurhan Torun, M.D., 2008

Tumor unchanged in volume by MRI, but increased visual field loss in superotemporal right eye
Summary

- Patient RR diagnosed with planum sphenoidale meningioma after presenting with vision loss in left eye.
- Lesion not detected initially because correct study not ordered.
- Order physician must select imaging of visual pathways based on possible location of lesion.
  - Vision loss in only one eye -> pre-chiasmal
  - Vision loss in both eyes -> chiasmal, post-chiasmal
References

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