Orbital Calcifications & Imaging of Optic Nerve Head Drusen

Charles Wykoff
Harvard Medical School, Year 3
Gillian Lieberman, MD
Outline

- Ms. GB’s head CT
- Differential diagnosis of orbital calcifications
- Orbital anatomy
- Images of the most common entities
- Techniques for visualizing optic nerve head drusen
Ms. GB’s Fall

- 94 year-old female lives alone in assisted living
- Found lying on her kitchen floor at 3AM complaining of severe L hip pain
- At presentation:
  - Unable to ambulate
  - Unable to give a history due to known dementia
  - PMH significant for CVA, HTN & CAD
- Upon admission → evaluated for a L hip fracture & intracranial hemorrhage
Ms. GB’s Head CT

No evidence of acute intracranial hemorrhage or edema. BUT, two calcified lesions were noted in the left globe.

Images: PACS, BIDMC; interpretation courtesy of S. Reddy, MD, BIDMC.
What now?

- What could the ocular densities be?
- What should be done about them?
Asymptomatic Orbital Calcifications

- 100 random orbital CTs
  - No Hx eye trauma or eye Sx
  - Normal fundoscopic exam
  - Mean age: 35y (range 3-85y)

- 8% found to have calcifications

DDx of Orbital Calcifications

- **Common:**
  - Scleral Plaque
  - Cataract
  - Trochlear Apparatus
  - Phthisis Bulbi
  - Drusen
  - Foreign Bodies

- **Uncommon:**
  - **Infectious:** Toxoplasmosis, CMV, Herpes. TB, syphilis
  - **Vascular:** Atherosclerosis, Phlebolith
  - **Neoplastic:** Retinoblastoma, Choroidal osteoma, Meningioma
  - **Hypercalcemia:** Hyperparathyroidism, Metastases, Vit D intox.
The orbit is a pyramid-shaped cavity of the skull formed by 7 bones (frontal, maxilla, sphenoid, zygoma, ethmoid, lacrimal and palatine). It protects the globe and its associated structures.

There are 6 striated extraocular muscles that move the globe: the 4 rectus muscles (SR, IR, MR, LR), the superior oblique (SO) & the inferior oblique (IO). Each rectus muscle’s tendon inserts into the sclera just posterior to the fornix and adjacent to the ciliary body.

The SO is the longest extraocular eye muscle; its distal tendon passes through the trochlear apparatus, a U-shaped piece of fibrocartilage attached to the medial orbital wall, turning laterally and inserting into the sclera below the SR. Contraction of the SO depresses, abducts and intorts the eye.

http://info.med.yale.edu/caim/manual2/graphics/illustrations.html
The lens is a biconvex disk composed of 35% protein, the highest protein content of any tissue in the body; therefore it is relatively dense on CT. It is suspended just posterior to the iris by the zonular fibers extending from the ciliary body.

The scleral lamina cribrosa is a sieve-like plate through which the optic nerve fibers pass on their way to lateral geniculate nucleus (LGN).
Relevant Orbital Anatomy 4

- Cornea
- Lens
- Sclera
- Optic Nerve
- Head
- Lateral Rectus Muscle
- Medial Rectus Muscle
- Optic Nerve
- Eye Lid

http://www.urmc.rochester.edu/smd/Rad/neurocases/Neuro302.htm
Orbital Anatomy: Quiz

What is misplaced and where is it?

L lens dislocated posteriorly, against retina

http://www.urmc.rochester.edu/smd/Rad/neurocases/Neuro302.htm
Calcified Scleral Plaque

- **Appearance:** Focal, anterior to rectus muscle insertion
  - $2/3 = MR$
  - $1/3 = LR$
  - Uncommonly = SR or IR

- **Cause:** Degenerative changes
  - 2º mechanical stress

- **Clinical:**
  - Associated with age:
    - Uncommon < 70
    - 23% at 80y
  - > 50% are bilateral

Calcified Cataract  

**Appearance:** Well defined, biconvex disk posterior to the cornea

**Cause:**
- Trauma (unilateral) $\rightarrow$ cortex
- Longstanding inflammation: uveitis (unilateral) $\rightarrow$ cortex + nucleus
- Mature cataract

Images: PACS, BIDMC; Information courtesy of R. Pineda, MD, MEEI; and S. Reddy, MD, BIDMC.
Calcified Trochlear Apparatus

- **Appearance**: Focal, at point of SO angulation, adjacent to the medial orbital wall

- **Cause**: Degenerative changes

- **Clinical**:
  - Associated with age:
    - 25-30% > 50y
  - If <40, consider diabetes mellitus
  - Odds ratio for detecting trochlear calcification in diabetic v nondiabetic = 4.3

Phthisis Bulbi Greek = “wasting”

- **Appearance:** Ocular structures → atrophic, disorganized & shrunken:
  - Terminal process = calcification, most commonly forming a crescent along the choroid

- **Cause:** Ocular degeneration
  - Trauma
  - Longstanding inflammation

Optic Nerve Head Drusen (ONHD)

**Appearance:** Well defined, punctate, located in the optic disc, anterior to the lamina cribrosa

**Cause:** Acellular deposits of degenerated nerve fibers

**Clinical:**
- 1-3% pop; 70-90% bilateral
- Caucasians
- Autosomal dominant w/ variable penetrance
- Present from early childhood
- Usually aSx
- 64-87% = visual field defects

What did Ms. GB have?

- Calcified Cataract
- ONHD

Images: PACS, BIDMC.
Why is imaging of ONHD important?

- May be mistaken clinically for papilledema!
- Fundoscopic appearance of ONHD:
  - Elevated optic discs
  - Raised, irregular disk margins (mulberry-like)
  - +/- visible drusen:
    - Deep: not directly visible
    - Superficial: whitish, bright focal lesions

Imaging of ONHD

- MRI
- Plain film
- CT
- Fluorescence Angiography
- Ultrasonography

Unreliable for detection


Advantages:
- Commonly preformed test, therefore if suspect, check records
- Detects deep & superficial drusen
- Useful for Dx ocular pathology that other imaging modalities might miss, for example retro-orbital lesions

Disadvantage
- Drusen: 0.05 – 3mm in size; therefore, even high-resolution, thin slice scans may not detect

ONHD – Fluorescein Angiography

- **ONHD is autofluorescent**
- **Advantage:**
  - No ionizing radiation
- **Disadvantage:**
  - Unreliable detection of deep drusen


ONHD – Ultrasonography / B-scan

- **Appearance:**
  - Highly echogenic lesion persists with low-gain scanning (<60 dB)
  - Posterior cone of shadow

- **Advantages:**
  - No ionizing radiation
  - Cheap
  - Portable
  - Detects both deep & superficial drusen
  - Entire disk area visualized

- **Disadvantage:**
  - Operator dependent

Imaging of ONHD: B-scan v CT v FA

36 eyes with suspected drusen imaged with 3 techniques:

<table>
<thead>
<tr>
<th>Drusen detected</th>
<th>B-scan: 21</th>
<th>CT: 9</th>
<th>FA: 10</th>
</tr>
</thead>
</table>

Summary: B-scan = imaging method of choice

Imaging of ONHD:  B-scan is best

Example: 41yo M w/ bilateral ONHD

B-scan detected both R & L ONHD

CT and FA detected only R ONHD

Summary

- Asymptomatic orbital calcifications are common
- Most entities are innocuous & readily identifiable given characteristic location and appearance
- If ONHD is suspected clinically, B-scan is the imaging modality of choice
References

Acknowledgements

Thanks!

Roberto Pineda II, MD
Steve Reddy, MD
Gillian Lieberman, MD
Pamela Lepkowskki
Larry Barbaras, Webmaster