AGENDA

• Introduce our patient
• Define and review Ddx of proptosis
• Review the anatomy of the eye and orbit
• Discuss different radiologic studies available for imaging the orbit
• Show examples of how these imaging modalities can be used distinguish between different causes of proptosis
• Return to our patient
The Patient

• 50 year old man riding bicycle hit by automobile

• Hit head on pavement

• Taken to the ED for evaluation

• Clinical exam notable for left proptosis; patient states that he has had this “forever”

• Head CT without contrast ordered to r/o intracranial bleed
Definition and Ddx of Proptosis

**PROPTOSIS**: protrusion of the eye with a difference of > 3mm between the two eyes.

**DIFFERENTIAL DIAGNOSIS OF PROPTOSIS:**

I. **DISORDERS OF EXTRAOCULAR MUSCLES**
   - dysthyroid eye disease, rhabdomyosarcoma

II. **INFECTIVE DISORDERS**
    - orbital cellulitis, preseptal cellulitis

III. **INFLAMMATORY DISEASE**
    - orbital pseudotumor

IV. **VASCULAR ABNORMALITIES**
    - carotico-cavernous fistula, AVM, orbital varix

V. **ORBITAL TUMORS**
    - optic nerve gliomas/meningiomas, lymphoma, mets, cavernous hemangioma
Review of the anatomy of the eye

From Robbins Pathologic Basis of Disease.
Review of the anatomy of the orbit

From James, Chew, and Bron. Lecture Notes on Ophthalmology, 8th ed.
Menu of Imaging Modalities for the Orbit

1. Plain film radiography
2. Ultrasound
3. CT
4. MRI
Normal Radiograph

Caldwell Projection

Waters Projection

Pros/Cons of Radiography

PROS

- Cost-efficient
- Good for initial evaluation of orbital trauma, esp fractures

CONS

- Limited ability to detect changes in tissue density
Choose radiograph when:

- you want to evaluate bony structure, ex. orbital fracture
- You want to evaluate sinus pathology
Orbital Cellulitis

- Infection of orbital soft tissue
- Often secondary to acute or chronic sinusitis
- Needs immediate treatment given risk of spread to CNS
Normal Ocular Ultrasound

Anterior

Lens

Anterior Chamber

Optic Nerve

Retina

Posterior

Posterior Chamber

## Pros/Cons of Orbital Ultrasound

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>safe/inexpensive</td>
<td>examiner dependent</td>
</tr>
<tr>
<td>Can detect calcifications</td>
<td></td>
</tr>
<tr>
<td>good for detection of intraocular foreign bodies, ocular tumors, retinal detachment, vitreous hemorrhage</td>
<td></td>
</tr>
</tbody>
</table>

Choose ultrasound to image the orbit when:

- you want to assess the presence or size of an ocular tumor
- you want to look for clues to characterize tumor tissue (ex. calcifications)
- a patient presents with an orbital process and you want to evaluate the orbit
- locate intraocular foreign bodies
Cavernous Hemangioma

- Most common benign orbital tumor
- Vasular orbital tumor, usually intraconal
- Affects middle-aged women
- Presents as slowly progressive axial proptosis

Well circumscribed retrobulbar mass with homogeneous irregular echo structure

Right Proptosis


Right Orbital Ultrasound

Carotico-cavernous fistula

- Arteriovenous communication between the carotid arterial system and the cavernous sinus

- Can be high flow or low flow

- Secondary to trauma or spontaneous


dilated superior ophthalmic vein
Normal CT

Globe
Lateral rectus
Optic Nerve
Medial rectus
Orbital apex

Pros/Cons of CT for orbital imaging

**PROS**

- Good for bony pathology/calcifications
- Lower cost than MRI
- Always used before MRI in cases of trauma

**CONS**

- Poor for imaging the soft tissues at the orbital apex

Choose CT to image the orbit when:

- you want to evaluate bony pathology
- you want to visualize calcifications
- the patient is s/p trauma
- there is a contra-indication to MRI
Thyroid Eye Disease

- Can occur with hyper OR hypo thyroidism
- Lymphocytic infiltration of EOM → enlarged EOM → impaired gaze/proptosis
- Can be unilateral or bilateral

Enlarged medial/lateral rectus muscles


Normal MRI

T1 (better anatomic detail)  T2 (better for detecting pathologic change)

Pros/Cons of MRI for orbital imaging

**PROS**
- good soft tissue contrast
- better for vascular and hemorrhagic lesions
- Good for work-up of well-circumscribed lesions

**CONS**
- cost
- Difficult to differentiate ill-defined lesion
Choose MRI to image the orbit when:

- you suspect an intraocular process involving the optic nerve (meningioma, glioma, etc)
- a patient presents with acute onset proptosis and you are unsure of the cause
- there is an intraocular tumor and you want to assess whether there has been extraocular extension
- there is a contra-indication to CT
Optic Nerve Glioma

- Most often present in children and young adults with unilateral proptosis and decreased visual acuity
- Usually benign
- Rarely spreads along optic nerve and invade chiasm
- 25-50% associated with neurofibromatosis

Back to our patient-
Axial CT without contrast

Retrobulbar soft tissue density throughout which are dispersed multiple round high-attenuation foci
Back to our patient-
Axial CT without contrast

Left middle cerebral artery

Large curvilinear region of high attenuation
Our Patient
MRI-Saggital View

Dilated veins
Our Patient
MRI- Axial View

multiple dilated flow voids within the left sylvian fissure
Our Patient’s Diagnosis: AVM

- congenital or acquired vascular lesion
- Most common form of intracranial hamartoma
- Usually presents as an ill-defined mass
- 70% of AVMs symptomatic by second or third decade of life
  - usually present with intracranial bleeds or seizures depending on size
- Endovascular or surgical treatment according to the location/type of lesion
Our Patient

Our patient refused treatment for this AVM. There was no significant acute trauma related abnormalities. The patient left AMA.
References

- Robbins Pathologic Basis of Disease.
Acknowledgements

• Larry Barbaras
• Jim Busch, MD
• Cara Lyn D’amour
• Ian Dunn
• Pamela Lepkowski
• Gillian Lieberman, MD
THANK YOU!