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2 ☐ **Bio**

- UHCO class of 2010
- Residency in Ocular Disease, Bridge Builders Eye Clinic
- Current associate at Eagle Mountain Family Eye Care, Lake Worth (formerly 1st Eye Care)

3 ☐ You never know what's going to walk in the door...

4 ☐ **Overview**

5 ☐ **What is the role of Neuroimaging in Eye Care?**

6 ☐ **Coordinated Care**

- The Radiologic Technologist
 - 2 yrs Associates degree or 4 yr Bachelor of Science

7 ☐ **Coordinated Care - Referrals**

- Neurologist
 - Pediatric Neurologist
 - John Honeycutt, MD
 - Hayden Head, MD (Ped Neuroradiologist)
 - Neuro-Ophthalmologist (4 in the DFW area)
 - John McHenry, MD
 - Sam Abdul-Rahim, MD

8 ☐ **Terminology Review**

9 ☐ **X-ray**

- Skull x-ray to pre-screen for metallic FB prior to MRI

10 ☐ **CT**

- Based on standard x-ray attenuation by tissues of various densities
- Rapid rotation of x-ray tube around patients
- Denser material (like bone) blocks/attenuates the x-ray beam and is "brighter" while less dense material (like air) allows the beam to pass through and is "darker"
- Radiation exposure = 115 chest x-rays or 1 yr of background radiation

11 ☐ **CT with contrast or without**

- Contrast material - Iodinated
 - Contraindications - prior allergic rxn or renal failure
- Improved sensitivity and specificity

- Should be used for most ophthalmic imaging
 - Exception:
 - Thyroid eye disease*

12 CT with and without contrast

13 CT of the orbit, head or both

- Orbital:
 - Images obtained at a different angle using thinner slices (0.7mm vs 3-4mm)
 - Can be reconstructed to any slice thickness (usually 2mm)
 - Most common planes are axial and coronal, sagittal views can be reconstructed
 - Coronal views show relationship btwn EOMs, optic nerve, and surrounding bone structures
- Note - 3-D reconstructions popular but can "smooth" over abnormalities and 2-D images should always be viewed as well

14 Indications for CT

ACUTE conditions

ie. trauma, HA, papilledema, vision/visual field loss, diplopia

If there contraindications to MRI - claustrophobia, severe obesity, cochlear implant, ferromagnetic aneurysm clip, pacemaker or other metallic FB

15 The ABC's of CT

- | | | |
|----------|--|-------------------------------|
| A | <u>Acute</u> study needed (bleeding, trauma, | hydrocephalus, emergent case) |
| B | <u>Bone</u> (fracture, sinus dz) | |
| C | <u>Calcification</u> (meningioma, | craniopharyngioma, |
| | retinoblastoma) | |

16 Calcified Lesions

17 Thyroid Eye Disease

18 MRI

- Based on detecting signal from resonance within a large magnetic field
- MR signal generated from interaction of hydrogen protons within the powerful magnetic field

Just how powerful you ask?

Fun fact...Tesla (T) is the unit that measures the magnetic field created by the MRI

19 Contraindications to MRI

- Absolute - cardiac pacemaker* and any retained or implanted metallic foreign body (in critical location)
- Difficult patients - movement disorders, children, claustrophobia
- 15-20 minutes per study, typically 8-10 studies

20 MRI

- Signal intensity
 - Hyperintense, isointense, hypointense
- 2 most common pulse sequences T₁ and T₂ - weighted images
 - Normal anatomy - T₁

- Intracranial or other pathology - T2
- Both typically acquired as part of MRI of orbit and brain

21 Most important tissue appearances on MRI

- FAT - bright/hyperintense on T1
- CSF - bright/hyperintense on T2

22 Pathology on MRI

- Most impT T1 hyperintense substances
 - Subacute hemorrhage
 - Proteinaceous fluid
 - Melanin (very hyperintense T1 and very hypointense T2) very useful in imaging choroidal melanomas or intracranial melanoma metastases.

23 Pathology on MRI

- Hyperintense T2 pathologies
 - Demyelinating lesions
 - Ischemia
 - Inflammatory dz
 - Toxic or metabolic disorders
 - Neoplasms

24 Optic Neuritis (example)

25 What is fat suppression?

- Allows better visualization
- Hyperintense fat signal can block contrast enhancement
- Can show content of fat-containing lesions ie orbital dermoid cysts and lipomas
- Should always use for post-contrast orbital T1 - evaluating optic nerve sheath meningioma or optic neuritis
- Usually, post-contrast fat suppression is standard (no need to order separately)

26 FLAIR - Fluid attenuation inversion recovery

- FLAIR sequences show pathological hyperintensity on T2 better
- Should order when looking for demyelinating disease
- Hyperintense T2 signal of CSF can mask pathology

27 GRE - Gradient Echo Sequence

- Shows blood very well, even trace amounts
- When used with T1 and T2, age of hemorrhage can be determined
- Good for looking at hemes associate with AV malformations and traumatic brain injury


28 Gadolinium Contrast in MRI

- Should be used for all neuro-ophthalmic imaging (unless CI)
- Minimal side effects - skin rash, sweating itching
- Previously thought safe for kidney dz, beware nephrogenic systemic fibrosis (NSF)
- MRI with contrast is no longer “no risk” for renal dz patients

29  **Contrast in MRI**

30  **2 is often better than 1**

- CT and MRI together may provide a more complete picture
- Especially in lesions that affect soft tissue AND bone

31  **Assessing Vascular Lesions**

- MRA and CTA has reduced need for invasive catheter angiography
- Iodinated contrast-filled vessels can be seen without interference from background tissue
- 3-D rotational images

32  **MRA**

- 2 types
 - Time-of-flight (TOF) MRA *preferred for ophthalmic imaging
 - Phase-contrast (PC) MRA
- **MRA** advantages over CTA
 - No iodine contrast
 - Less nephrotoxic
 - Increased signal-to-noise ratio
 - Easier post-processing techniques
- **CTA** advantages over MRA
 - Increased spatial resolution
 - Technically easier, faster to study
 - Less motion artifacts

33  **Third Nerve Palsy**

- Pupil involvement?
- For partial/complete EOM involvement WITH pupil involvement
 - Traditional method - invasive catheter angiography
 - MRA or CTA
 - Usually MRI/MRA

34  **Third Nerve Palsy**

35  **Third Nerve Palsy**

- Vasculopathic patients with complete external WITHOUT pupil involvement
 - Can be observed - likely ischemic
- Without vasculopathic risk factors or vasculopathic patients that don't improve or progress over several months - imaging indicated**
- MRA and CTA - up to 98% sensitivity in identifying aneurysm leading to third nerve palsy

36  **MRA and CTA - other uses**

- AV malformations

37  **MRA and CTA - other uses**

- Dural or carotid-cavernous fistula

38  **MRA and CTA - other uses**


- Suspected carotid artery disease

39  **MRV and CTV**

- MRV/CTV used to exclude dural venous sinus thrombosis in cases of papilledema from increased ICP
 - Cerebral venous sinus thrombosis (CVST) can have same symptoms of idiopathic intracranial HTN (CVST is a rare stroke involving thrombosis of dural venous sinuses that drain blood from the brain)

40  **Indications - Vision Loss**

- Unilateral or bilateral vision loss
 - Unilateral or bilateral optic neuropathy
 - Junctional scotoma
 - Bitemporal hemianopsia
 - Homonymous hemianopsia
 - Cortical blindness

41  **Indications - Pupillary Defects**

- Efferent pupillary defects
 - Anisocoria due to Horner's syndrome or 3rd nerve palsy
- Afferent pupillary defects
 - RAPD
 - Light near dissociation

42  **Indications - Orbit**

- Thyroid eye disease
- Orbital tumors
- Idiopathic orbital inflammation
- Orbital cellulitis
- Carotid-cavernous fistula

43  **Indications - Lid Abnormalities**

- Lid retraction
- Lid lag
- Ptosis
- Orbital lid lesions

44  **Indications - Fundus Abnormalities**

- Papilledema
- Optic atrophy
- Optic nerve hypoplasia
- Optic disc drusen
- Choroidal folds

45  **Ordering Imaging**

- Relevant clinical findings
- Suspected lesion location
- Differential diagnoses
- Urgency of imaging request

46 **Where to send**

- Private imaging centers
 - Radiology Associates www.radntx.com
 - Preferred Imaging www.preferredmri.com
- Hospitals
 - OD privileges
 - Wait time

47 **Form**

48 **Locations with Carotid Doppler**

- Bedford
- Camp Bowie
- Hulen
- N. Arlington
- Pennsylvania Ave
- S. Arlington
- Southlake
- Plano

49 **Reasons for Imaging in Eye Care**

32 per 10,000 cases imaging was ordered (ophthalmic services in hospital)

1. Suspected compressive lesions in anterior visual pathway
2. Acquired ocular motility disturbance
3. Orbital lesion
4. Cerebrovascular event
5. Headache
6. Sinusitis

50 **Case Reports**

1. Severely asymmetric glaucoma
2. CN 6 Palsy and Temporal Arteritis
3. Pseudotumor cerebri (presumed)
4. Bilateral Papilledema
5. Thyroid eye disease
6. Ocular Ischemic Syndrome

51 **Asymmetric Glaucoma**


- 68 Hispanic Female
- Presented to BB diagnosed with POAG (since 2007) treated in Mexico with Kryptan (brimonidine, timolol, dorzolamide) and Xalatan
- LPI OU performed in Mexico

52  **Asymmetric Glaucoma**

Clinical Findings

- BCVA OD 20/30 OS 20/25
- Mild/Mod DES and MGD
- LPI's superior OU
- NS and cortical cataracts OU
- Gonio - open to CB, no pigment, very slight anterior bowing


- POAG OD>>OS
- Referred for CT

53  **Optic Nerve**

54  **Visual Field**

55  **OCT**


56  **CT Results**

57  **CN 6 Palsy and Temporal Arteritis**

- 60 yo WF, elevated cholesterol
- Sudden onset diplopia, after visit to chiropractor
- HA and tenderness on left side of head x 10 days

- Right CN6 palsy, suspect temporal arteritis
- Immediate MRI and CBC/Sed rate/CRP

58  **MRI Results**

59  **Neurologist report**

60  **Pseudotumor Cerebri (presumed)**

- 37 black female
- Moderately overweight, hypertensive
- Reports 'tension HA' in the evening
- Hx of breast cancer surgery 2003
- Meds: Diltiazem, HCTZ, tylenol prn

61  **Clinical Findings**


- BCVA 20/20 OD, OS 20/20
- IOP 20, 20
- 2 old corneal scars OD
- Mild HTN retinopathy

62  **Optic Nerve**

63 

64  **OCT**

65  **MRI Results**

66  **Bilateral Papilledema**

- 12 yo WF
- Requests CL exam
- 20/20 OD, OS

- Bilateral elevated rim tissue and NFL
- HA symptoms revealed upon further questioning

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68 

69  CT

70  MRI

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72 

73  **Thyroid Eye Disease**

- 68 Black Female
- Previously dx'd with HTN, hyperthyroid, age-related arthritis
- Meds: Synthroid, Clonidine, Lisinopril, Diltiazem, Premarin
- Reported OS more prominent than OD x 2 yrs, stable
- (-) dip, (-) pain with eye mvmt

74  **Clinical findings**

- BCVA 20/20 OD 20/25 OS
- Asymmetric proptosis OS>OD, (-) EOM restrictions
- Mild bulbar hyperemia, no significant DES
- 3+ cortical and 2+ NS cataract OU
- Normal ONH, macula, and fundus

- MRI without contrast of brain and orbit
- Refer for cat sx

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77  **MRI Report**

78  **Ocular Ischemic Syndrome**

- Pt referred by fellow OD for retinal evaluation
- Hx of squamous cell carcinoma of the base of the tongue, prior neck sx and radiation
- DM type 2, HTN, RA, carotid artery dz

- 20/30 OD, 20/25 OS. Normal IOP

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81  **References**

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