OUR GREATEST HITS

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CASE DISCUSSIONS

Carotid Cavernous Sinus Fistula:

- Rupture of intracavernous portion of internal carotid artery (ICA) or meningeal branch
  - Meningohypophyseal, McConnell's Capsular, or Inferior Cavernous artery
- Mixing of high pressure oxygenated blood into low pressure deoxygenated venous system

Fistulas: Classification

- Hemodynamically
  - High flow (ICA rupture) or low flow (meningeal branch)
- Angiographically
  - ICA or meningeal branches ruptured
- Etiology
  - Traumatic (ICA rupture) or spontaneous (meningeal branch)
    - Theorized that there are small aneurysms on meningeal branches in hypertensive, middle age females which rupture and lead to low flow fistula

Carotid Cavernous Sinus Fistula: Signs and Symptoms

- Increased venous pressure
- Orbital congestion
- Proptosis (pulsatile)
  - Corneal exposure
- Arteriolization of conjunctival and episcleral vessels
  - "Caput Medusa"
    - Medusa's head of snakes
- Orbital bruit
- Myopathies and cranial neuropathies with diplopia and ophthalmoplegia
- Secondary glaucoma from increased episcleral venous pressure
  - High-pressure arterial blood increases pressure in venous system.
  - Blood backs up and moves toward eye through superior ophthalmic vein
  - Episcleral veins increase pressure
    - IOP always exceed episcleral venous pressure

Carotid Cavernous Sinus Fistula: Management

- Vision threatening – not life threatening

- Spontaneous etiology – spontaneous resolution
- Wait it out for a few months – monitoring is most prudent
- Traumatic
- Clipping and ligation
- Balloon or particulate embolization
- Glaucoma difficult to manage
- Prostaglandin analogs most suited because they decrease IOP independent of episcleral venous pressure

CN III Palsy: Aberrant Regeneration

- When damage to the CN III results in a resprouting and miscommunication of nerves to muscles
- Inferior rectus and medial rectus communicates with levator
- Medial rectus communicates with pupil
- Clinical picture:
  - Patient looks medial: lid elevates
  - Patient looks lateral: lid lowers
  - Patient looks down: lid elevates (Pseudo-Von Graefe's). This typically is the most identifiable sign in primary or secondary aberrant regeneration
  - Patient looks medial: pupil constricts

CN III Palsy: Two Types of Aberrant Regeneration:

- Primary: Occurs independent of antecedent CN III Palsy. Caused by aneurysm or meningioma within cavernous sinus
- Secondary: Occurs after an antecedent CN III palsy. Causes:
  - Aneurysm within subarachnoid space, trauma, tumor, inflammation
  - NEVER DIABETES! If cause of CN III palsy is determined to be ischemic vascular (diabetes, HTN, etc.) and then the eye undergoes aberrant regeneration, the initial diagnosis is wrong. You must re-examine for tumor or aneurysm within ipsilateral cavernous sinus.

Mass Lesion

- Brain and orbital tumors may be primary lesions or result from metastasis from primary tumors originating elsewhere. Brain tumors can directly and indirectly affect the systemic and visual systems.
- Brain tumors can occur spontaneously and idiopathically or as part of a genetic hereditary syndrome.
- When they grow large enough, intracranial masses have the ability to displace or compress functional elements inside the cranium (both tissue and vascular) impacting structure and function.
- Depending upon the tumors location, mentation and language expression may become altered (expressive and motor aphasia). Memory may become impaired or hallucinations may be perceived (via mechanical fascicular stimulation).
- As tumors enlarge inside the closed cranial vault they compress brain tissue and elevate intracranial pressure either directly or through ventricular blockage with resultant hydrocephalus.

This can create systemic effects such as nausea, headache (often present upon waking and worsening throughout the day), tinnitus (ringing in the ears), vertigo (feeling as though the world is spinning), disequilibrium (inability to maintain balance), referred back pain, seizures and local ocular effects such as anisocoria, pulsatile proptosis, optic disc edema (true papilledema), transient visual changes and isolated or multiple cranial nerve palsy. Vomiting without nausea is an ominous indicator of increased intracranial pressure, possibly from a brain tumor. Vomiting can be seen as a response meant to dehydrate the body and relieve intracranial pressure.

- Tumors requiring formidable vascular supply can induce anemia or ischemic cerebrovascular accident (ischemic stroke-CVA) along with all of its systemic and ocular effects. If they or their vascular supplies hemorrhage they can induce hemorrhagic cerebrovascular vascular accident (hemorrhagic stroke-CVA) along with its consequences.
- The common tumors affecting the eye and visual pathway include pituitary adenoma, meningioma, glioma/astrocytoma and neurofibromas and hemangioblastoma
- Computed tomography (CT), magnetic resonance imaging (MRI), magnetic resonance angiography (MRA) and magnetic resonance venography (MRV), under the guidance provided by the practitioner, can correctly concentrate on the proper anatomic area of suspicion. Once the lesion is located it can be identified based upon patient profile, neuroimaging features, systemic signs and symptoms, appearance, behavior, location or cell type if biopsy is possible.
- Generally, there five strategies for the treatment of brain tumors: 1. Monitor and treat symptoms; small slow growing non-malignant tumors may not require removal or modification as their rate-of-change is so slow they may never impact a patients quality-of-life. 2. Surgical removal; resection must be done with great care as collateral damage may impact quality-of-life as much or more than allowing the tumor to remain. 3. Irradiation; accurately aimed internal beam radiation systems have the ability to thermally destroy tumors inside the cranium without being surgically invasive. 4. Medical therapy; chemotherapy is a traditional avenue for tumor removal when surgical resection is not possible because of location or patient frailty. 5. Deprive the blood supply; vascular endothelial growth factor inhibitors (VEGFI) can involute tumor vascular systems and are effective for some tumors with minimal side effects.

Blunt Trauma

- Common complications of Blunt Trauma to internal anterior segment
    - Traumatic hyphema
    - Iritis
        - hypotony
    - Mydriasis
    - Iridodialysis
    - Phakodonesis
        - Lens subluxation
    - Cyclodialysis
        - Angle recession
- Ciliary Effusion
        - Ciliochoroidal effusion
            - With choroidal effusion
            - Abnormal collection of fluid in the suprachoroidal space
                - Typically caused by hypotony
            - May develop retinal/choroidal folds

        - Perpetuate hypotony by reducing aqueous production and increasing uveoscleral outflow
        - Rotates Ciliary Body anterior
        - Reduce tension on zonules
            - Lens thickening
                - Induced myopia
        - Iris-Lens diaphragm shift anterior
            - Induced myopia
        - Shallow anterior chamber
        - Angle closure potential
    - Clinical Features
        - Shallow anterior chamber
        - Induced Myopia oftentimes >5D
        - Potential for angle closure glaucoma
        - Potential for hypotony
    - Diagnostic Management
        - UBM preferred
        - Anterior segment OCT
    - Treatment
        - Cycloplegics
            - Atropine
        - Anti-inflammatories
            - Steroids
                - Oral Steroids
                - Topical steroids
            - Non-steroidals

Neuroretinitis

- Inflammation of the optic nerve
    - leading to optic nerve swelling and surrounding retina
        - Results in a serous detachment that typically involves lipid deposition
            - resulting in a macular star formation
- **Cat Scratch Disease (CSD)**
    - Cat Scratch Disease is the most common associated etiology of infectious neuroretinitis
    - systemic infection

• **Epidemiology**
    - Caused by the Bartonella gram-negative bacillus
        - Typically Bartonella henselae
    - CSD is found worldwide and associated with domestic and feral cats
        - About 40% of cats may be infected
    - Typically age 18 and younger with slightly greater incidence in males
    - Hospital admissions more common in adults
    - Seasonality peak incidence in Fall-Winter in US

• **Clinical Manifestations**
    - Typically self-limiting and benign infection
    - Linear scratch abrasion developing a pustule lesion

- Lymphadenopathy is most common involving node closest to drainage of lesion
- Flu-like symptoms – Malaise – Fatigue – Fever
- Immuno-compromised patients are at great risk of systemic and ocular involvement
- Anterior Segment
  - Parinaud's Oculoglandular Syndrome
  - Anterior uveitis might be present
- Posterior Segment
  - Neuroretinitis
    - Sudden Painless Vision Loss
    - Typically unilateral but may be bilateral (rare)
    - ONH Swelling
    - Intra retinal hemorrhages may be present
    - Macular exudative star may form within first 3 weeks
      - Lipid rich fluid leakage has been demonstrated to originate from an optic disk vessel accumulating in a star or radial pattern in the outer plexiform layer
      - VA can range from 20/20 to LP
    - Mild to moderate Vitritis may be present
    - Less Common Posterior Segment
      - White Dot Syndrome has been associated
      - Venous and Arterial occlusions have been reported

• **Making the Diagnosis**

- Thorough case history
  - Inquire about pet exposure
    - Cats and kittens
  - Suspicious skin lesions
    - Flea bites
  - Recent travel
- Clinical Presentation
  - Presence of neuroretinitis is highly suspicious of CSD
- OCT is helpful in detecting early serous elevation
- Lab Testing
  - Bartonella henselae serum antibody titer
    - B. henselae IgG
    - B. henselae IgM

• **Treatment**

• Since CSD is typically self-limiting and benign, antibiotic treatment is optional in immunocompetent patients

• For immunocompromised patients or those patients where antibiotic therapy is desired the following antibiotics have been reported to be efficacious

- Azithromycin
- Ciprofloxacin

- Rifampin
- Gentamicin
- Trimethoprim Sulfamethoxazole
- Penicillins, cephalosporins, tetracyclines, erythromycin
- There is not a general consensus in the literature on the most efficacious antibiotic

• **Clinical Pearls**

- CSD the most common infectious etiology associated with neuroretinitis
- A thorough history including past animal exposure, presence of skin lesions and travel is paramount
- The condition is self-limiting and the prognosis for complete resolution with acuity returning to normal is very good
- Lab testing should include Bartonella henselae IgG and IgM titers
- When antibiotic therapy is employed, doxycycline 100mg bid for 6-8 weeks appears to be effective.

My patient has an APD. Now what?

A. Case presentation

B. Differential Diagnosis of RAPD
1. Optic Neuropathy (Unilateral, Bilateral AND Significantly Asymmetrical)
2. Severe retinal defect (eg, RD, vascular occlusion, large macular scar)
3. Severe amblyopia (mild RAPD, Dx of exclusion)
4. Severe cataract (inverse RAPD, Dx of exclusion)

C. Differential Diagnosis of VF presentation
1. Unilateral vs Bilateral VF defect
2. Neurological vs Retina

D. Further findings
1. Fundus Photos:
   a) ONH: Normal OU
   b) Macula: thinning OD?
2. SD-OCT: Macular/GCC thinning OD
3. What is the link?

E. Retrobulbar Optic Neuritis/Multiple Sc
1. Resolution of OCT has evolved to allow for isolation of retinal layers making it possible to quantify the thickness of the ganglion cell complex (GCC) in the macular area
2. GCC is constituted of the cell bodies (or ganglion cell layer or GCL) and dendrites (or inner plexiform layer or IPL) of the ganglion cells which axons form the RNFL. It thus provides a direct analysis of the integrity of the neuronal ganglion cells and ultimately their axons.
3. **Optic Neuritis:**

a) Inflammation of the optic nerve and is strongly associated with multiple sclerosis
b) 30-70 % of patients with MS will develop an episode of ON
c) ON is the presenting sign of MS in 20-30% of the time
d) Almost half of the patients with ON have white matter lesions consistent with MS
e) The 5-year risk of developing MS is highly dependent on the number of MRI lesions, but may also occur in patients with absence of any lesion
f) At 15 years follow-up, the overall risk of developing MS is 72% for patients with MRI lesions and 25% for patients without any white matter lesions.

4. OCT findings in MS and ON

a) RNFL analysis in patients with unilateral ON presenting as an isolated event has shown that RNFL thickness decreases over months after the attack and stabilizes at around 6-12 months with an average of 20% loss in the affected eye
b) The extent of damage in ON does not seem to be a predictive factor of MS development, as it is mostly related to the severity of the attack and/or the presence of pre-existing damage due to previous optic nerve head injury.
c) However, in patients with MS, RNFL thinning seem to be affecting both eyes and not only the eye with history of ON.
d) Moreover, MS patients without any known episodes of ON in either eye also show RNFL thinning in both eyes
e) Macular thickness also demonstrates thinning in MS patients with or without ON. This thinning seems to be mostly located at the level of the inner retina, and more specifically at the level of the GCC which extent of loss correlates with the extent of RNFL loss.

f) **Mechanism (3 theories):**
   (1) asymptomatic episodes of subclinical ON **or**
   (2) retrograde trans-synaptical degeneration **or**
   (3) primary neurodegeneration of the ganglion cells and their axons in the absence of inflammation.
g) The latter theory suggests that loss of axons and ganglion cells may be due to a direct mechanism of MS affecting these ocular CNS neurons, which makes it possible to use RNFL and macular/GCC thickness as markers for disease progression in MS patients

Help! My patient can't adduct!

Case Presentation

Differential Diagnosis of Limited Adduction (with negative forced ductions)

5. Internuclear Ophtalmoplegia
6. Partial 3rd nerve palsy
   a) Presentation of 3rd nerve palsy: Complete vs Partial
   b) Extremely rare to have involvement of one muscle only

c) Convergence affected

7. Myasthenia Gravis
   a) Presentation
   b) Signs (Variable with fatigue, Cogan's lid twitch, Ptosis on sustained superior gaze)
8. Grave's Disease

F. <u>INO</u>

1. Presentation (unilateral)
   a) Disorder of conjugate lateral gaze in which the affected eye shows impairment of adduction
   b) The contralateral eye abducts with nystagmus
   c) Convergence intact/better
   d) Exotropia in primary gaze (except for mild cases)

2. Pathophysiology
   a) Dysfunction in the medial longitudinal fasciculus (MLF) in the brainstem
   b) Center for lateral gaze in the pons:
      (1) 6th nerve nucleus innervates ipsilateral lateral rectus
      (2) interneurons synapse in contralateral MLF on medial rectus motor neurons within the 3rd nerve nucleus

3. Symptoms
   a) Diplopia
   b) Oscillopsia
   c) May have other symptoms of brainstem disease
      (1) Vertigo, Limb numbness, Weakness

4. Causes
   a) Stroke (38%)
   b) MS (34%)
   c) Other causes (28%)
      (1) Tumors
      (2) Hemorrhage
      (3) Infection, etc

5. In young patients, especially women, MS is likely the cause
6. **Treatment**
   a) Underlying cause
   b) If MS: usually resolves with time

G. <u>Testing/Diagnosis/Management</u>

1. Suspect Multiple Sclerosis: OCT findings
   a) GCC thinning
2. Pt referred to Neurology
3. MRI of brain (with contrast) confirmed diagnosis of MS
4. Periodic Macular and NFL OCT to assess MS progression

80-year-old man reports a sudden loss of vision OD

i) Vision is count fingers at 2 feet OD and 20/25 OS
ii) APD OD grade 4
iii) Fundus photos OU

b) Fundus photos OU – discussion
c) CRAO Treatment/Work-Up/Follow-Up?
   i) Previous treatment/work-up/follow-up
      (1) Anterior chamber paracentesis (less than 24 hours)
      (2) STAT blood work
         (a) CBC with diff
      (3) 2-10% of all CRAOs are caused by thrombosis from Giant Cell Arteritis (GCA)
      (4) Sed-rate
      (5) C-reactive protein
         (a) Qualitative or quantitative
      (6) Monitor for neovascularization, every 3-6 weeks
d) New treatment/work-up/follow-up for CRAO, BRAO, TIA (amaurosis fugax)
   i) Acute Stroke Ready Hospital
      (1) Certification recognizes hospitals that meet standards to support better outcomes for stroke care as part of a stroke system of care
      (2) Developed in collaboration with the Joint Commission (TJC), eligibility standards include:
      (3) Dedicated stroke-focused program
      (4) Staffing by qualified medical professionals trained in stroke care
      (5) Relationship with local emergency management systems (EMS) that encourages training in field assessment tools and communication with the hospital prior to bringing a patient with a stroke to the emergency department
      (6) Access to stroke expertise 24 hours a day, 7 days a week (in person or via telemedicine) and transfer agreements with facilities that provide primary or comprehensive stroke services.
      (7) 24/7 ability to perform rapid diagnostic imaging and laboratory testing to facilitate the administration for IV thrombolytics in eligible patients
      (8) Streamlined flow of patient information while protecting patient rights, security and privacy
      (9) Use of data to assess and continually improve quality of care for stroke patients
   ii) Warn hospital is suspicion for GCA
e) 20% of stroke or heart attack within 3 years
   i) However, of those who experienced CVA or MI
      (1) 80% were within 24-48 hours; those remaining
      (2) 50% occurred in 2 weeks
      (3) Majority within the next 90 days
f) Not PCP, not retinologist, just the Acute Stroke Ready Hospital!
g) Reference: Management of Acute Retinal Ischemia: Follow the Guidelines! Ophthalmology. 2018 April 28. Biousee V., Nahab F, Newman NJ.
   i) Emory Eye Center – Emory University, Neuro- Ophthalmology

35 year old man wants another opinion due to “hemorrhage on my right eye”

ii) Happened 3 days ago after vomiting, claims food poisoning from chicken Caesar salad
iii) Still feels a little nauseated
iv) Saw ophthalmologist 3 days ago, told he had a bruise on his eye and it should go away in 1-2 weeks
v) BVA 20/100 OD, 20/70 OS
(1) Hx of amblyopia OD
(2) Current Rx OD +5.50 OS +4.50

h) Any concerns?
i) Patient noticed blurry vision OS
ii) Started 2 weeks ago
iii) Did not mention because he is more concerned about the blood on his right eye

i) Headaches for 2 weeks, decrease if patient stands up
i) ROS: unremarkable
ii) Decide to dilate OU

j) Retinal Findings- Discussion of phots
i) Differential Diagnosis
(1) Hypertensive retinopathy
(2) Blood dyscrasia
(3) Terson’s syndrome
(4) Valsalva retinopathy
(5) Purtscher’s retinopathy
(6) Shaken baby syndrome

k) Terson’s Syndrome
i) Terson’s syndrome originally was defined by the occurrence of vitreous hemorrhage in association with subarachnoid hemorrhage.
ii) Terson’s syndrome now encompasses any intraocular hemorrhage associated with intracranial hemorrhage and elevated intracranial pressures.
iii) Intraocular hemorrhage includes the development of subretinal, retinal, subhyaloidal, or vitreal blood.
iv) The classic presentation is in the subhyaloidal space.

l) Treatment
i) Emergency referral to neurologist due to high suspicion of intracranial hemorrhage and elevated intracranial pressure

m) Findings
i) Intracranial hemorrhage confirmed with MRI
ii) Patient later diagnosed with Hairy Cell Leukemia and cryptococcal meningitis