Neuro-Ophthalmic Diagnoses
You Don’t Want to Miss

Course Description

- This lecture introduces the Optometric Physician to the top ten malpractice litigations within the area of neuro-ophthalmic disease over the past three decades.
- The objective is to understand how to avoid delay in diagnosis that in some situations can cause permanent loss of vision, neurologic dysfunction, or even death.

Course Instructor

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Credentials

- Dr. Talley is a board certified (ABO) Optometric Physician at a large optometric group practice in Memphis, Tennessee.
- He trained Optometric Externs and Residents for 20 years and has given over 1000 presentations in the areas of primary eye care, ocular disease and practice management.

Advocacy

- Dr. Talley has served in every elected position of the Tennessee Board of Optometry (TNBO) and the Tennessee Association of Optometric Physicians (TAOP).
- He has also served in many capacities for the American Optometric Association (AOA) to include the Third Party Center Executive Committee.

Commercial Disclosure

- The content of this course was prepared independently by Dr. Talley without input from members of the ophthalmic industry.
- Dr. Talley has no direct financial or proprietary interest in any companies, products or services mentioned in this presentation.
Knowing Neuroimaging?

- **Structural imaging** deals with the structure of the brain and the diagnosis of gross (large scale) intracranial disease (such as tumor), and injury.

- **Functional imaging** is used to diagnose metabolic diseases and lesions on a finer scale and also for neurological and cognitive psychology research and building brain-computer interfaces.

Computed Tomography (CT)

- A series of x-rays of the head taken from many different directions.
- Typically used to detect infarction, tumors, calcifications, haemorrhage and bone trauma.

Brain Imaging Techniques

**Computed tomography (CT)** scanning of the head that reveals Hypodense (dark) structures indicate infarction or tumors; hyperdense (bright) structures indicate calcifications and haemorrhage and bone trauma can be seen as disjunction in bone windows.

Magnetic Resonance Imaging (MRI)

- Magnetic fields and radio waves to produce high quality two- or three-dimensional images of brain structures without use of ionizing radiation (X-rays) or radioactive tracers.
Brain Imaging Techniques

**Magnetic Resonance Imaging (MRI)**
The brain provides better tissue contrast than computed tomography, and it has less artifacts than CT when viewing the brainstem. MRI is also superior for pituitary imaging. It may however be less effective at identifying early cerebritis.

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**Magnetic Resonance Angiography (MRA)**
- Time-of-flight MRA showing the circle of Willis in the brain.
- Note the "venetian blinds" artifact visible as the multiple pseudo-stenosis on both the left and right middle cerebral artery.

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**Case 1**
- A 55 YOWF with well controlled hypertension and diabetes complains of diplopia and headache for 2 days.
- She has a left upper-eyelid ptosis and reduced infraduction, supraduction, and adduction of the left eye.
- The pupils are equal-sized in dim illumination, but the left pupil constricts slightly less in direct light.

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Case 1

• A brain computed tomography is done and shows a subarachnoid hemorrhage from a ruptured cerebral aneurysm.
• The patient DIES soon after the scan is taken.

Case 1

• 1b: Brain computed tomographic (CT) scan taken in emergency room 1 hour before death shows subarachnoid hemorrhage.

Aneurysmal Third Cranial Nerve Palsy

Case 1

1c: A catheter cerebral angiogram, if done earlier, would likely have shown a berry aneurysm (arrow) at the junction of the carotid artery and the posterior communication artery indenting the third nerve on the left side.

Aneurysmal Third Cranial Nerve Palsy

Case 1: Pupil Peril

The pitfall here is believing that the lack of anisocoria in an isolated third-nerve palsy excludes an aneurysm or other compressive lesion.

a. TRUE
b. FALSE

Case 1

• The pupil is affected in over 90% of aneurysmal third-nerve palsies
• Half of patients diagnosed with aneurysmal third-nerve palsy experience subarachnoid hemorrhage within 2 weeks
• Half of the patients who hemorrhage will die.

Case 1

What type of imaging is necessary to diagnose aneurysms?

a. Catheter Cerebral Angiography
b. MRI
c. MRA
d. CT Scan
Imaging in Aneurysms

- Catheter Cerebral Angiography remains the gold standard, but will cause stroke or myocardial infarction in 1% - 2% of patients; even more in the elderly and those with arteriosclerosis.

Clinical Caution

Cautions to keep in mind about aneurysmal third-nerve palsy:
- Clinical features do not perfectly exclude aneurysm as the cause of third-nerve palsy.
- A patient should undergo catheter angiography for diagnosis promptly unless the index of suspicion is relatively low or the risk of serious complication from the procedure is high.

Case 2

- An 81YOWF, with no recorded ophthalmic abnormalities at her last visit 6 months previously, telephones her ophthalmologist’s office late one Friday afternoon to report blurred vision in her right eye of 1 day’s duration.
- She says she cannot read with the involved eye but has very good vision in the other eye.

- Over the weekend, the patient goes completely blind in both eyes.
- Examination on Monday confirms no vision in either eye, as well as large, unreactive pupils and swollen optic discs.

Giant Cell Arteritis

Optic Disc Edema in both eyes consistent with Infarction
Case 2

- Temporal artery biopsy reveals granulomatous arteritis
- Despite treatment with high-dose corticosteroids, she remains blind

Case 2: Failing Fellow

The pitfall here is not realizing that acute visual loss in an elderly patient—even without prominent systemic symptoms—could be due to giant cell arteritis and that it can strike the fellow eye within hours or days.

a. TRUE
b. FALSE

Neurology News!

The “One-Third Rule” in Giant Cell Arteritis is, if the optic nerve in the second eye is to become infarcted...

...it will do so within 48 hours in one third of untreated patients; within 1 week in another one third and within 1 month in one third of patients. Second eye infarctions after more than 1 month are rare.

Assume Arteritis

If the patient is over 70 years of age and
- Visual acuity is 20 / 200 or worse
- Arteriosclerotic risk factors are negligible
- Jaw claudication, scalp tenderness, headache, limb girdle muscle aches or weakness, anorexia, or anemia is present
- ESR or C-reactive protein is elevated

GCA Treatment Tale

- High-dose corticosteroid treatment does not restore vision but usually prevents infarction in the fellow eye.
- Current regimens employ prednisone 1.5 mg/kg, or a “jump start” with IV methylprednisolone 1-2 g/d for 3 days followed by prednisone 1.5 mg/kg.
GCA Treatment Tale

- A temporal artery biopsy should be performed within a week of starting corticosteroids.
- The specimen should be at least 2.5 cm long and a minimum of 100 sections should be examined.
- If the biopsy is negative but the suspicion is high, biopsy the opposite side.

GCA Treatment Tale

- 10% - 14% of cases will be positive on the other side.
- If the biopsy is positive, the corticosteroids dose should be gradually tapered off as systemic symptoms disappear and the ESR normalizes.
- Corticosteroid treatment is usually maintained for about a year.

Clinical Caution

Cautions to keep in mind about giant cell arteritis:
- Acute visual loss in the elderly carries a presumptive diagnosis of giant cell arteritis, even w/o systemic symptoms.
- Office staff should be aware that elderly patients with acute loss of vision must be examined urgently.

Case 3

- A 65YOWM consults an ophthalmologist for blurred vision in the right eye of uncertain duration.
- Examination discloses best corrected visual acuities of 20/30 OD and 20/20 OS.
- Fundus examination through clear media reveals confluent macular drusen binocularly.

Case 3

- Pupillary reactions are recorded as normal, but the examination is performed by the assistant, not the ophthalmologist.
- The subnormal acuity is attributed to the drusen.
- The patient is given an Amsler Grid with standard instructions and is scheduled for a follow-up appointment in 1 year.
Case 3

- Over the next 6 months, the patient notes failing vision OD and consults another ophthalmologist.
- Best corrected acuities are now 20/100 OD and 20/25 OS.
- A right afferent pupillary defect is noted.
- Automated perimetry discloses a temporal hemianopic defect OS.

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Tumor Treatment

- Because most of the tumor was extrasellar, the patient underwent a transcranial (rather than the safer transsphenoidal) surgical removal of the craniopharyngioma.
- The patient's final visual acuity was 20/50 OD and HM OS.

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Diagnosis Delay

Errors delaying the diagnosis of anterior visual pathway tumors:
- Not comparing brightness of light between two eyes.
- Failing to recognize hemianopic features in the visual fields.
- Assuming that a normal appearing optic disc excludes optic neuropathy.

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Malpractice Mistakes

In children with visual acuity loss, malpractice cases often arise over two mistakes in pupillary examination:
- Failure to elicit a relative afferent pupillary defect (RAPD) because the child would not hold still... use Direct Ophthalmoscope.
- Attributing an RAPD to amblyopia.

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Clinical Caution

Cautions to keep in mind about anterior visual pathway tumors:
- Macular abnormalities can distract the clinician from a diagnosis of anterior visual pathway tumor.
- Pupillary reaction and visual field examination must be tested with good technique.

Clinical Caution

Cautions to keep in mind about anterior visual pathway tumors:
- All Low/Normal Tension Glaucoma patients should have pupils evaluated very carefully to look for an APD as well as subtle optic atrophy and visual field loss that respects the midline.

Case 4

- A 60 YOWF with tuberculosis and chronic renal failure is placed on ethambutol 15 mg/kg, with rifampicin 600 mg/day and isoniazid 300 mg/day.
- Within 3 months, she complains of foggy vision in both eyes.
- An ophthalmologist finds visual acuity of 20/30 OU and attributes to cataracts.

Case 4

- The cataracts are extracted, but within 8 months, her acuity has fallen to 20/400 OU
- Examination now shows binocular temporal disc pallor and cecocentral field defects that are mistaken for bitemporal hemianopia. A brain MRI scan is normal.
- The ethambutol is eventually discontinued, but the patient’s visual acuity recovers to only 20/60 OU

Case 4

Ethambutol Optic Neuropathy

Static Threshold (Humphrey Field Analyzer) Visual Fields showing binocular cecocentral scotomas. The defects could easily be mistaken and indeed were for bitemporal hemianopia.

Case 4:

The pitfall here is failing to realize that progressive symmetric visual acuity loss with normal pupils and ophthalmoscopy can conceal toxic optic neuropathy, even in a patient treated with standard doses of ethambutol.

a. TRUE
b. FALSE
**Case 4**

Ethambutol optic neuropathy is…?

a. Rare (< 5%) with standard doses  
b. Is much more common in patients with renal failure, those of advanced age and low body weight (120 lbs.)  
c. Exhibits no ophthalmoscopic abnormalities, in early stages  
d. All of the above are true

**Clinical Caution**

Cautions to keep in mind about ethambutol optic neuropathy:

- Standard dose regimens of ethambutol can cause optic neuropathy that presents as insidiously progressive binocular visual acuity loss without any visible ocular abnormalities.

**Case 5**

- A 50 YOWM consults an ophthalmologist for a 1 week history of two episodes of sudden blurred vision in the left eye.  
- There are no accompanying symptoms or precipitating circumstances.  
- He reports several decades of episodic 15 minute visual scintillations sometimes followed by headache

- He has been diagnosed with migraines  
- He has had hypertension for years and smokes two packs of cigarettes per day  
- His ophthalmic examination is normal.  
- The recent transient visual loss episodes are ascribed to migraine, and he is placed on aspirin 325 mg per day

**Imaging in Atherosclerosis**

- Duplex ultrasound is an acceptable screening study  
- Conducted by expert technicians, it is quick, painless, free of complications, and highly sensitive to stenosis  
- If greater than 70% cross sectional stenosis, endarterectomy is recommended

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The pitfall here is attributing an episode of transient visual loss without “positive phenomena” (photopsias, scintillations) to migraine, especially in a patient who has risk factors for carotid atherosclerosis.

a. TRUE  
b. FALSE
Evidence for Endarterectomy

- Results of large collaborative trials in North America and Europe confirm benefit if greater than 70% stenosis
- Endarterectomy reduced the 2 year risk of major stroke from 16% to 8% in patients who had recent brain hemispheric transient ischemic attacks (TIAs) or minor strokes

Clinical Caution

Cautions to keep in mind about ocular transient ischemic attacks:
- Transient monocular visual loss in an adult must be presumed to derive from cervical carotid thromboembolism.
- If attacks are recent or are becoming more frequent, the patient is at risk for imminent hemispheric stroke.

Case 6

- A 3 YOWM is brought to an ophthalmologist because of recent in-turning of the eyes
- The child is also being evaluated by a pediatrician for difficulty walking
- The child’s poor cooperation limits the ophthalmic examination, but he fixes and follows with either eye

- Approximately 35 prism diopters of comitant esotropia are present
- Ductions are full, and retinoscopy suggests a 2 diopter hyperopia OU
- An attempt at fundus examination elicits a fierce struggle with the child, and an adequate view is not obtained

- The diagnosis is accommodative esotropia
- The child is given a prescription for 2 diopter spectacles, and is scheduled to return in 2 months
- Upon follow-up the patient’s esotropia behind the spectacles is unchanged
- His parents report that the boy is now staggering and falling frequently

- With sedation and restraints, ophthalmoscopy reveals chronic optic disc edema bilaterally
- MRI discloses hydrocephalus caused by a fourth ventricular tumor
- The surgical pathology is Posterior Fossa Medulloblastoma
Case 6

- In this brain MRI scan, the fourth ventricle is invaded by a large medulloblastoma.
- In addition, all ventricles are dilated, reflecting hydrocephalus.

**Posterior Fossa Medulloblastoma**

Case 6:

The pitfall here is failing to acknowledge that new onset childhood comitant esotropia can be a sign of increased intracranial pressure (ICP), and that proper fundus examination must be pursued in spite of patient resistance.

a. TRUE
b. FALSE

Wild Child!

**What to Do:**
- Use toys
- Use games
- Use food
- Use restraints
- Use medications

Examination Under Sedation (EUS)

- Utilizes medication to sedate a child prior to examination.
- Allows for a more thorough examination when child is uncooperative.
- May also be used to help calm or relax adult patients who are nervous or tense.

Sedative – Hypnotic Agents

**Chloral Hydrate**

- For oral and rectal dosage form (capsules, syrup or suppositories):
  - 50mg per kilogram (kg) (23 mg per pound) of body weight… 30 to 60 minutes prior to examination.

EUS Calculations

- Weight: 39 pounds
- 2.2 pounds = 1 kilogram
- 39 / 2.2 = 17.73 kilograms
- 50 mg / kg standard dosage
EUS Calculations

- Chloral Hydrate Syrup (500 mg / 5ml)
- 886.50 mg x 5 ml = 500 mg (?) ml
- 8.87 ml Syrup given

Wild Child... Post Sedation

- 5 ml given @ 2:00 pm; vital signs normal
- Another 3.75 ml given @ 2:30 pm; vital signs normal

Tech Talk

The neurologic manifestations of gait disturbance in this patient was recorded by an assistant, but not reviewed

How should you talk to your tech?

Clinical Caution

Cautions to keep in mind about esotropia and increased ICP:
- Increased ICP can be the cause of new onset esotropia, particularly if other neurologic manifestations are present or if the classic features of congenital or accommodative esotropia are not present.

Case 7

- A 14 YOWF develops headaches and blurred vision in both eyes over a 3 days
- Visual acuities are 20/30 in each eye, pupils react normally
- Fundus examination discloses bilateral optic disc edema and cotton wool spots remote from the optic nerve head

Case 7

- This fundus shows optic disc edema with peripapillary and retinal cotton wool spots initially attributed to inflammation.
Case 7

- The patient is diagnosed with bilateral papillitis and started on intravenous methylprednisolone
- However, 3 days later develops a left hemiparesis, and computed tomography reveals a right putaminal hemorrhage

Case 7:

**The pitfall here is forgetting that bilateral optic disc edema associated with retinal cotton wool spots could be caused by malignant hypertension.**

a. TRUE
b. FALSE

Vital Values

- Measuring blood pressure, pulse and respiration is good medical practice in any patient who has disc edema or cotton wool spots...even in children.
- Also don’t forget to review and document the presence or absence of Focal Neurologic Symptoms (FNS)

Cotton Clues

- Optic disc cotton wool spots are common in ischemic, inflammatory, and neoplastic optic neuropathies
- However in malignant hypertension, the retinal arterioles are also involved, so that cotton wool spots can appear more than two disc diameters from the disc

Clinical Caution

Cautions to keep in mind about malignant hypertension:
- Malignant hypertension may be overlooked as a cause of swollen optic discs and cotton wool spots, particularly in children.
Case 8

- A 40 YOAF with insulin dependent diabetes develops malaise and diplopia
- Her blood sugar is 600 mg/dL, and urine shows ketones
- Ophthalmic examination discloses findings consistent with an isolated left third cranial nerve palsy that spares the pupil

Case 8

- There are no other ocular adnexa abnormalities
- She is judged to have a diabetic third nerve palsy and treated for diabetic ketoacidosis
- However, 3 days later she loses abduction of the left eye, and 1 day after that she loses all sight in that eye

Case 8

- MRI discloses an opacified left ethmoid sinus and reduced enhancement of the medial and superior rectus muscles which are completely infarcted
- Biopsy of the ethmoid sinus reveals mucormycosis

Case 8

- 7a: Coronal brain T1 weighted and enhance MRI shows opacification of left ethmoid sinus and reduced enhancement of infarcted medial and superior rectus muscles.

Case 8

- 7b: Ethmoid mucosal biopsy discloses branching hyphae typical of mucormycosis (sustained in methenamine silver)

Case 8

- She is treated with intravenous antifungal agents, but the delayed diagnosis forces exenteration of the left orbit and paranasal sinuses
- She is cured, but cosmetically deformed as well as being impaired
Case 8

7c: MRI scan taken after exenteration of left paranasal sinuses and orbital tissues.

Case 8:
The pitfall here is failing to realize that an ocular motor palsy in a patient with diabetic ketoacidosis or in any other immunocompromised state could be caused by mucormycosis and other life threatening orbitocranial infections.

a. TRUE
b. FALSE

Fungi Facts

- The fungi that cause mucormycosis thrive in the acid medium of ketoacidosis.
- They will invade and thrombose blood vessels, killing sino-orbital and intracranial tissues by ischemic necrosis.
- Rapid correction of the metabolic imbalance must be combined with high dose intravenous antifungal therapy.

Clinical Caution

Cautions to keep in mind about sino-orbital mucormycosis:
- An ocular motor palsy in an immunocompromised patient, particularly a patient with diabetes in ketoacidosis, must be presumed to result from sino-orbital or meningeal infection.

Case 9

A 15 YOWM complains that within the past 2 months he has had three episodes of vertical diplopia lasting several hours.

The last episode was accompanied by some gait instability.

He feels fine now, and his ophthalmic examination is normal.

He is told to return if symptoms recur.

Case 9

- However, 6 months later, he experiences the explosive onset of diplopia, garbled speech, and four limb weakness.
- Examination now shows bilateral horizontal gaze palsies, together with severe dysarthria and quadripareisis.
- Brain MRI discloses an Arteriovenous Malformation (AVM) with hemorrhage.
Case 9
• Axial T1 weighted brain MRI shows a large area of abnormal signal in the pons, indicative of hemorrhage in an arteriovenous malformation.

Pontine Arteriovenous Malformation

Case 9:
The pitfall here is failing to realize that diplopia, even if intermittent, is not a benign symptom, particularly if it is vertical and another neurologic symptom is present.

a. TRUE
b. FALSE

Decompensated Decisions
• The intermittent diplopia that represents breakdown of a pre-existing phoria is usually horizontal
• The diagnosis of diplopia secondary to a decompensated phoria is a diagnosis of exclusion

Clinical Caution
Cautions to keep in mind about intermittent diplopia:
– Diplopia is not an innocent symptom, even when intermittent, especially if image separation is vertical and other neurologic symptoms are present.
– Despite a normal ophthalmologic examination, brain imaging is indicated.

Case 10
• A 50 YOWM develops diplopia
• Ophthalmic examination reveals a mild abduction deficit in the right eye
• Brain MRI of the patient is normal
• Forty-eight hours later, an examination shows complete ophthalmoplegia OU
• The ophthalmologist arranges for a neurology consult 5 days later

Case 10
• The next day the patient experiences respiratory arrest and is resuscitated in the emergency room, but suffers residual hypoxic brain damage
• The diagnosis ultimately proves to be acute inflammatory demyelinating polyneuropathy …the Miller-Fisher variant of Guillain-Barre’ syndrome
Case 10:

The pitfall here is failing to realize that rapidly progressive bilateral ophthalmoplegia could be part of a condition that leads within weeks to respiratory failure.

a. TRUE  
b. FALSE

Clinical Caution

Cautions to keep in mind about rapidly progressive ophthalmoplegia:

– Rapidly evolving ophthalmoplegia is a neurologic emergency, because it could be part of myasthenia gravis, Guillain-Barre’s syndrome, or botulism.

– All of these diseases can quickly compromise respiration.

Acknowledgement

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Disclaimer

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Talk to the Teacher

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