The Patient with Visual Loss: Localization of Neuropathologic Disease and Select Diseases of Neuropathologic Interest

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Shared embryology
- Eye and brain develop from neuro-ectoderm
- Their functions and responses to disease are related
- Blood ocular/brain barriers
- The eye is a window into the brain and systemic disease

Ocular anatomy
- Unique example of structure supporting function
- Optics
- Neuro-transduction
- Neuro-transmission

Normal left ocular fundus
- Optic disc
- Retinal vessels
- Transparent retina
- Macula
- Retinal pigment epithelium
- Choroid

Retinal nerve fiber layer anatomy
- Papillomacular bundle begins the macular-cortical projection
- Ganglion cells and axons respect the horizontal raphe

Retro-bulbar visual anatomy
- Optic nerves carry information from each eye
- Axons from the nasal retinas cross at the optic chiasm
- Optic tracts carry right and left sided visual information
- Thalamus
- Optic radiations
Localization and characterization of impaired vision

- Pattern of visual loss may identify the lesion site
- Disease course and accompanying symptoms may clarify its nature

Patterns of visual loss

- Scotomas
- Central vision
- Peripheral vision
- Symmetry/congruity change as information nears cortex

Ocular causes of impaired vision

- Refractive error
- Media opacity
- Retinal disease
- Optic nerve disease

Retinoblastoma

- Most common intraocular malignancy in childhood
- Leukocoria and strabismus
- 13 q14 mutation
- Spreads along the optic nerve into the brain

Retinoblastoma
A rapidly growing primitive neuroectodermal tumor that may show retinal differentiation in the form of Flexner-Wintersteiner rosettes
Retinal causes of impaired vision

- Symptoms
- Age-related macular degeneration is the most common cause of visual loss > 65 years
- Diabetic retinopathy is the most common cause of visual loss < 65 years

Centrocecal scotomas

Symptoms and signs of optic nerve disease

- Blurred vision
- Dimming of vision with decreased color perception
- Decreased pupillary response to light
- Centrocecal, and arcuate scotomata

Bilateral optic atrophy with centrocoecal scotoma

- Hereditary (dominant, Leber’s)
- Toxic (medications, methanol, heavy metals)
- Nutritional (folate, B12)
- Demyelinating (optic neuritis, multiple sclerosis)
Unilateral optic nerve disorders

- Ischemic (anterior ischemic optic neuropathy, retinal occlusive disease)
- Compressive (orbital, anterior fossa)
- Inflammatory (demyelinating, infectious, rheumatologic)

AION

- Patients usually > 50
- Sudden, usually stable visual loss
- Altitudinal scotoma
- Optic atrophy in 4-6 wk
- Causes
  - Idiopathic (anatomic)
  - Giant cell arteritis

Giant cell arteritis

- Senior citizens
- Subacute, granulomatous, stenosing arterial disease
- Headache, amaurosis fugax, arthralgia, myalgia, weight loss
- Brain, cardiac, eye, skin, muscle end artery damage

Compressive optic neuropathy

- Progressive scotoma
- Initially normal disc
- Signs of atrophy
  - Decrease in color
  - Decrease in vessels
  - Decrease in NFL

Inflammatory optic neuropathy

- Children and younger adults
- Centrocecal, arcuate, and hemianoptic scotomas
- Subacute, often painful
- Retrobulbar neuritis or papillitis

Papillitis and retrobulbar neuritis

Childhood

Adult
Other causes of optic atrophy

- Glaucoma
- Secondary to retinal degeneration
- Central retinal artery obstruction
- Post-papilledema
- Congenital anomalies: hypoplasia, coloboma

Glaucoma

- Common, usually bilateral, often asymmetric optic neuropathy
- Initial selective damage to branching axons

Retinal degeneration

- Photoreceptor and/or retinal pigment epithelium disturbance
- Vascular narrowing is earliest sign
- Pigment released from damaged RPE cells clumps or migrates into the retina
- Many causes

Central retinal artery obstruction

- versus other disc swelling
- Intracranial mass
- Pseudotumor cerebri
- Hydrocephalus
- Intracranial hemorrhage
- Venous thrombosis
- Meningitis
Papilledema in a 12 year old with idiopathic intracranial hypertension

Other causes of disc swelling
- Optic neuritis
- Anterior ischemic optic neuropathy
- Central retinal vein occlusion
- Diabetic papillopathy
- Infiltrative disorders
- Hypertension
- Pseudopapilledema

Lesions of the chiasm
- Usually compressive
- Pediatric
  - Hypothalamic glioma
  - Craniopharyngioma
- Adult
  - Pituitary adenoma
  - Meningioma
  - Craniopharyngioma
  - Aneurysm

Retrochiasmal lesions
- Hemianopic scotoma
- Grossly incongruous field defects
- Small afferent defect
- Children: neoplasm > vascular > trauma
- Adults: vascular > neoplasm > trauma

Retrogeniculate lesions
- Normal pupils, nerves unless perinatal
- Superior hemianopia: temporal lobe
- Inferior hemianopia: parietal lobe
- More posterior: more congruity
Select Neuro-ophthalmic manifestations of systemic diseases

- Tay Sachs & Sandoff's
- Niemann Pick type A
- Metachromatic leukodystrophy
- Sialidosis
- Farber disease

Cherry red spots

- Mucopolysaccharidoses, Gaucher’s, Refsum,
- Neuronal ceroid lipofuscinosis, cystinuria
- Abetalipoproteinemia, Kearns-Sayre
- Hallervorden Spatz, Spinocerebellar ataxias
- Usher, Cockayne

Retinal pigmentary degeneration

- Mucopolysaccharidoses, Gaucher’s, Refsum,
- Neuronal ceroid lipofuscinosis, cystinuria
- Abetalipoproteinemia, Kearns-Sayre
- Hallervorden Spatz, Spinocerebellar ataxias
- Usher, Cockayne

Optic atrophy

- Krabbe, Metachromatic leukodystrophy
- Adrenoleukodystrophy, Alexander
- Spinocerebellar ataxia type I
- Friedreich’s ataxia, Canavan’s,
- Pelizaeus-Merzbacher, Alper’s

Ocular manifestations of diabetes

- Clinical background and pre-proliferative disease
- Proliferative disease
- Diabetic papillitis
- Neovascular glaucoma
- Cataract
Ocular manifestations of hypertension

- Narrowed arterioles
- Hypertensive retinopathy
- Hypertensive choroidopathy
- Hypertensive optic neuropathy

Neurofibromatosis

- Dominant with complete penetrance and variable expressivity
- Skin, brain, eye, bone, visceral
- Ocular signs: Lisch nodules, optic nerve glioma, choroidal hamartoma

Tuberous sclerosis

- Hamartomas: skin, kidney, eye, brain, heart
- Dominant and new mutations
- Symptomatic: seizures, MR, facial angiofibromas, hydrocephalus
- Cortical hamartoma = tuber
- Retinal astrocytic hamartoma

Sturge-Weber syndrome

- Port wine stain
- Glaucoma
- Leptomeningeal angioma and seizures

Summary

- Visual loss can be understood when knowledge of neuropathophysiology is combined with knowledge of ocular embryology and anatomy
- The pattern of visual loss can localize and identify neuropathologic disease
- The number of systemic diseases having neuro-ophthalmic manifestation is legion