Pupils

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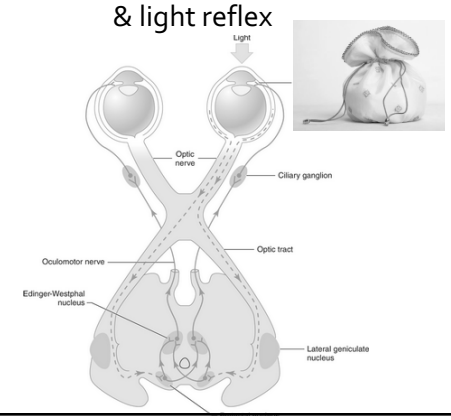
March 7, 2018

Function

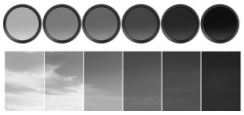
- Control retinal illumination
- Control depth of focus
- Minimize spherical aberrations
- Integrity of the retina, optic nerve
- Integrity of iris muscles and their innervation

Anatomy: iris spincter muscle & light reflex

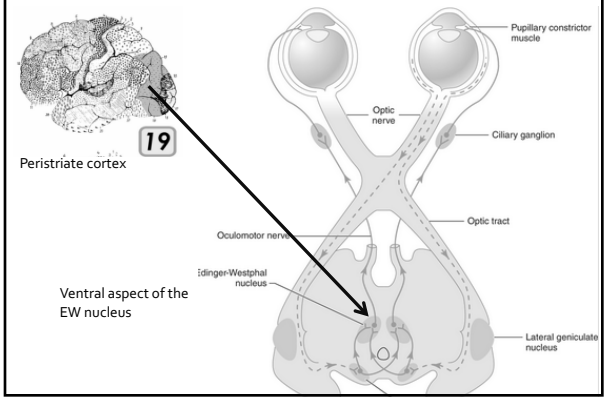


Afferent Pupillary Defect

- Swinging flashlight test
- Quantified using neutral density filters to neutralize the APD
- Localizes to retina, optic nerve, chiasm, or tract



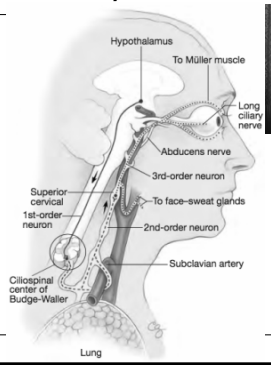
Anatomy: Near stimuli

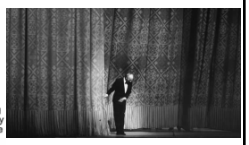


Light-near dissociation

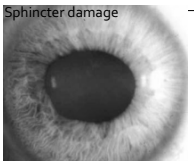
- Reacts better to near stimuli than to light
  - Optic neuropathy
  - Extensive retinal damage
  - Adie pupil
  - Argyll Robertson pupil
  - Dorsal midbrain syndrome
  - Aberrant regeneration of CN III

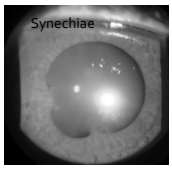
Anatomy: iris dilator muscle

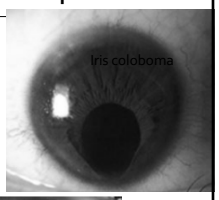


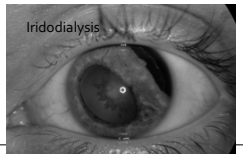


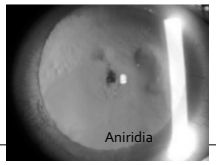
Pupil irregularity & slit lamp exam



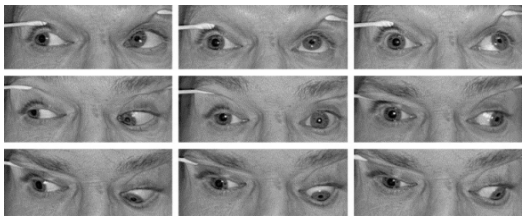








Motility and Ptosis



Anisocoria

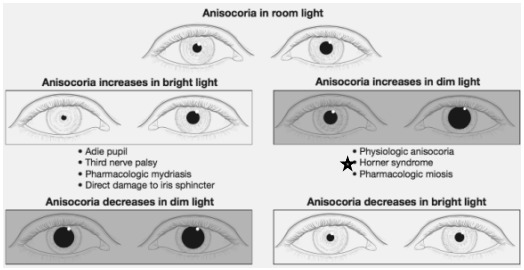
5 steps

1. Anisocoria worse in light or dark?
2. Pupil reacts to light?
3. Light-near dissociation?
4. Ptosis or motility disorder?
5. Iris abnormalities at slit lamp?

Physiologic anisocoria

- Up to 1/5 general population
- Usually <1mm
- Same in the light and dark (but sometimes worse in the dark)
- Varies day to day
- Changes sides

Compare anisocoria in light and dark



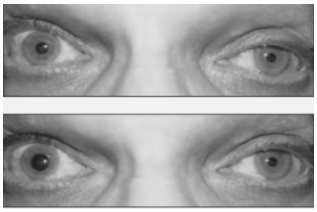
Horner syndrome

- Ptosis, miosis, anhydrosis
- Anisocoria worse in the dark
- Dilation lag helps distinguish from simple anisocoria

Pharmacologic diagnosis of Horner

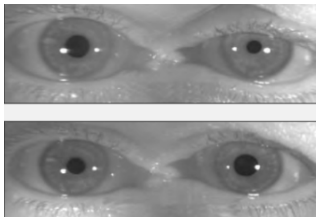
- 4% Cocaine blocks NE uptake in iris dilator
  - normal pupil dilates after cocaine
  - Horner's pupil has little NE, so unaffected by cocaine
  - No longer used
- 0.5% Apraclonidine alpha 2 & weak alpha 1 agonist
  - takes advantage of hypersensitive alpha-1 receptors on Horner's dilator muscle which occurs ~5 days after injury
  - Causes reversal of anisocoria
  - Respiratory depression in children < 1 year old
- Can I just use brimonidine?
  - No, it's a pure alpha 2 agonist

Cocaine testing in Horner



Lack of pupillary dilation in left eye confirms left Horner syndrome

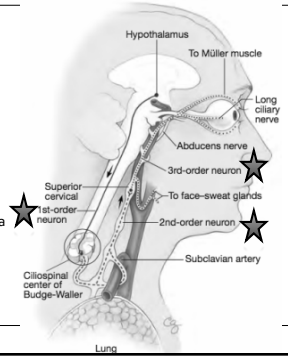
Apraclonidine testing in Horner



Reversal of aniscoria and improvement in ptosis confirms left Horner syndrome

Localize the lesion

Infarct
Neoplasm
Demyelination
Syrinohydromyelia



Carotid dissection
Cavernous sinus lesion
Trigeminal autonomic
Intraoral tumor, trauma
Petrositis, otitis media
Skull base, parasellar, orbital lesions

Trauma/surgery
Neoplasm, Pancoast tumor
Lymphadenopathy

Localize the lesion

- 1% hydroxyamphetamine
  - Enhances release of NE from postganglionic neuron
  - Preganglionic lesion: both pupils dilate
  - Postganglionic lesion: involved pupil dilates less → aniscoria worsens
  - Rarely used clinically
- By history and exam
  - Trauma to chest, neck, spine?
  - Associated neurologic signs?
  - Arm pain, weakness, numbness?
  - Ipsilateral face or neck pain?

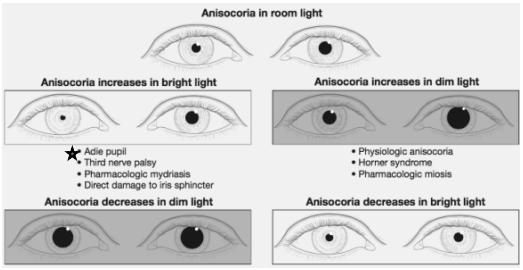
Pediatric Horner syndrome

- Signs of congenital Horner or acquired within 1 year of life:
  - Contralateral hemifacial flush and ipsilateral blanching
  - Contralateral curly hair and ipsilateral straight har
  - Contralateral darker iris and ipsilateral lighter iris
- Clear history of birth trauma and iris heterochromia suggest benign etiology, but always consider mass lesion (neuroblastoma)

Imaging

- Isolated Horner without CN palsy
  - CT/CTA neck to skull base offers views of the neck soft tissue and carotid artery lumen
  - MRI/MRA neck to skull base and CT chest
- MRI brain for central lesions

Compare anisocoria in light and dark

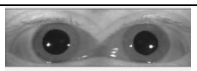


Adie pupil

- Damage to the ciliary ganglion or short ciliary nerves
- Poor reaction to light
- Sectoral iris sphincter palsy
- Pharmacologic testing with pilocarpine 0.125% (Adie pupil is supersensitive and constricts more)
- Acute stage
  - Accommodative paresis
  - No light near dissociation
- Chronic stage
  - Light near dissociation

Acute Adie pupil

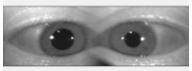
Dim light: Adie pupil slightly pupil bigger



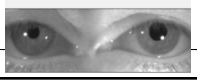
Room light

Bright light: Adie pupil much bigger

Does not constrict with near effort (no light-near dissociation)



After pilocarpine, miosis in Adie pupil due to supersensitivity



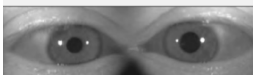
The Little Old Adie Pupil & aberrant reinnervation

Dim light: Adie pupil slightly smaller due to aberrant reinnervation of the sphincter muscle

Room light: anisocoria increases

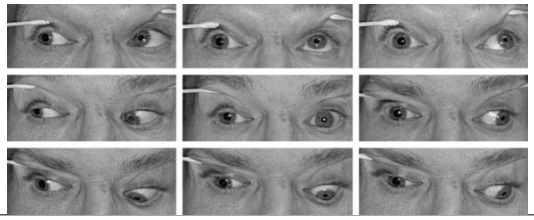
Bright light: anisocoria increases

Near reflex: light near dissociation due to aberrant reinnervation of iris sphincter by accommodative nerves



CN III Palsy

- Pupil involving third usually associated with ocular motiliy abnormality and ptosis
- Rule out aneurysm



Pharmacologic mydriasis

- Not reactive to light
- Not reactive to near stimulation
- No sectoral palsy
- Does not constrict well with pilocarpine 1%

Iris sphincter dysfunction

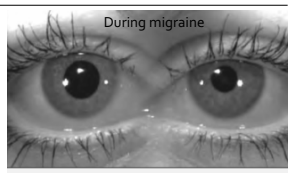
- Trauma
- Acute rise in IOP
- Pigmentary dispersion
- Pseudoexfoliation
- ICE
- Surgery
- VZV, siderosis, carotid artery disease, Miller-Fisher

Episodic: Migraine associated

- Headache
- Ipsilateral

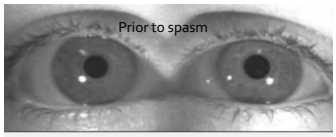
larger pupil, blanching, eyelid retraction

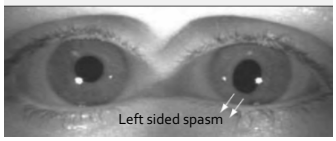
- Sympathetic overaction



Episodic: Tadpole pupils

- Triggered by exercise
- Sectoral spasm of the iris dilator





References

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