

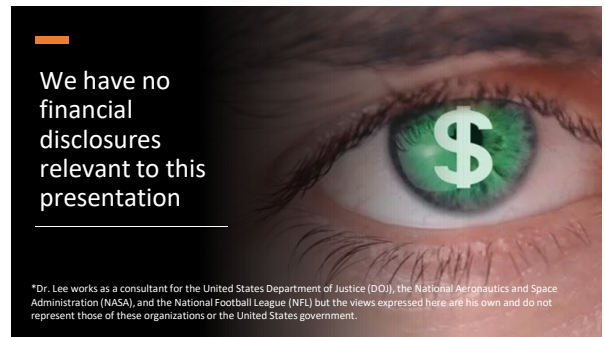
## What if?... The Pupil Showed This

### • **Andrew G. Lee, MD**

- Professor of Ophthalmology, Neurology and Neurosurgery, Weill Cornell Medical College
- Chair, Department of Ophthalmology, Houston Methodist Hospital, Houston, TX
- Adjunct Professor, University of Iowa Hospitals & Clinics, Iowa City, Iowa, Baylor COM, UTMB, UTMDACC



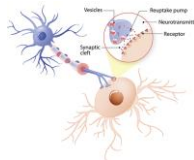
1



2

## What are we really covering?

- **Anatomy**
- **Neurotransmitters**
- **Autonomic nervous system**

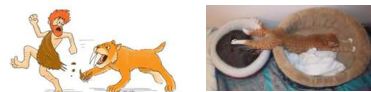


<https://qbi.uq.edu.au/files/27919/what-are-neurotransmitters-QBI.jpg>

3

Goal:  
you should be able to

- Describe the autonomic nervous system (ANS)
- Sympathetic nervous system (SNS)
- Parasympathetic nervous system (PNS)



<https://www.illustrations.org/wp/wp-content/uploads/2015/08/light-or-flight.jpg>  
<https://img.buzzfeed.com/buzzfeed-static/static/enhanced/web304/2012/2/16/enhanced-buzz-18881-1328131142-75.jpg>

4

Goal:  
you should be able to

- Give an overview of the pupil pathway
- Differentiate Afferent from Efferent pathways



<http://newlife4paths.net/images/image004.jpg>



<https://contemplativelife.wordpress.com/2012/08/06/wall-garden-1200x.jpg>

5

Goal: You  
should be  
able to

Describe how location and  
local structures directs  
your differential diagnosis

List several causes of a  
“perilous pupil” tailored to  
the findings and location

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## Perils by location look at local structures

### •VITAMIN

- Vascular: aneurysm, malformation
- Infectious: Syphilis, TB
- Tumor: anything taking up space
- Anatomic: variation from the norm
- Metabolic: Thyroid
- Inflammatory: Sarcoid
- Neoplastic: primary or metastatic

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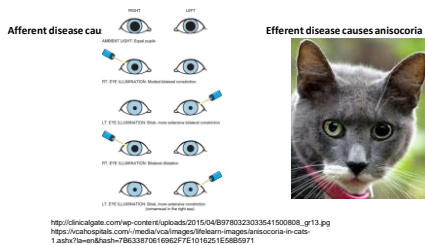
## To understand neural pathways, simplify...

- Stimulus (light) is received by the retina
- Retina transmits message to brain by neurons
  - "Relay station" between neurons is a synapse
- Afferent neurons: eye to brain
- Efferent pathway: brain to end organ
  - Iris sphincter
  - Extra-ocular muscles



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## Afferent, Efferent: 2 different pathways



9

## If you find afferent and efferent, the patient has TWO lesions

- Repeat your pupil exam

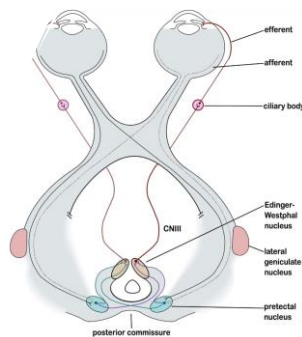


[https://d4y9y9u4r6m2.cloudfront.net/video/thumbnails/DF30c/pupil-reaction-test-with-light\\_sg1v04\\_F0000.png](https://d4y9y9u4r6m2.cloudfront.net/video/thumbnails/DF30c/pupil-reaction-test-with-light_sg1v04_F0000.png)

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## Afferent system = APD

- Remember the Chiasm
- Prechiasmal
  - Ipsilateral
- Post-chiasmal APD
  - Contralateral
  - 53% of fibers cross



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## Two types of Afferent fibers

- Vision fibers
- Pupil fibers



[http://arts.brighton.ac.uk/\\_data/assets/image/0008/2011/yinyan-g-1a.jpg](http://arts.brighton.ac.uk/_data/assets/image/0008/2011/yinyan-g-1a.jpg)

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## Afferents



## Vision fibers

Synapse: lateral geniculate nucleus (LGN)



## Pupil fibers

Bypass the LGN without synapse  
Synapse first in midbrain (pretectal nucleus)

Synapse again bilaterally

- Edinger-Westphal nuclei; CNIII
- Neuron between these synapses: interneuron

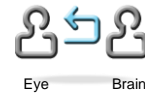


<http://kidsblogs.nationalgeographic.com/globalbrots/images/skipping-stones-at-avalarche-lake.jpg>

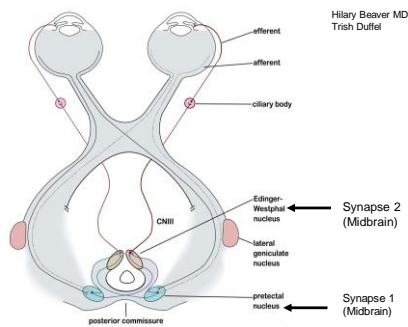
13

After the interneuron:  
Efferent fibers

- **Bilateral** post-synaptic fibers return to **both** eyes
- Same impulse sent to both pupils
- Explains the equal **direct** and **consensual** response
- Neural impulse causes pupil response



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Hilary Beaver MD  
Trish Duffell

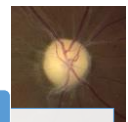
Afferent  
disease:  
sites for  
pupil perils

- Interruption of impulse from retina to midbrain
- Damage causes afferent pupillary defect (APD)
- Large retinal lesion
- Lesion of optic nerves, optic tracts
- Lesion of isolated pupil fibers all the way to midbrain
- May retain good vision or have vision loss
- RAPD not covered in PERRLA!
- You must test for and document relative afferent pupillary defect (RAPD)

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P<	5mm	3mm	No
	D(ark)	L(ight)	APD
	5mm	3mm	No

Afferent pupil perils:  
Lesions of the optic nerve

## Large retinal lesion

- Macula

## Optic nerve disease

- Tumor: Optic nerve glioma or meningioma
- Demyelinating disease
- Multiple sclerosis
- Ischemia
- Giant cell arteritis

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2725040/figure/fig1>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2725040/figure/fig1>

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### Pupil perils: nerve compression

- Orbital disease
  - Graves disease
  - Tumors
- Brain tumors: malignant or benign
  - Meningioma
    - Frontal, olfactory groove, sphenoid ridge
    - Foster-Kennedy Syndrome
  - Pituitary (apoplexy, tumor)



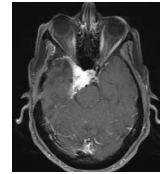
<http://webeye.ophth.uiowa.edu/eyeforum/cases/pages/Thyroid-Eye/fig2-TED-LRG.jpg>  
<http://www.ocular.net/donator502/prof/tebook/duanes/graphics/figures/v2/02405101.jpg>

Courtesy of AG Lee, MD

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### Pupil perils: Inflammatory/ infectious involvement to chiasm

- Sarcoidosis



Courtesy of AG Lee, MD

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### The forgotten afferents

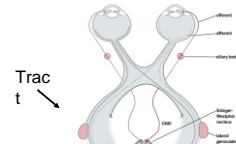
- Optic tracts, Midbrain



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### The forgotten afferents

- Optic tracts
  - 53% pupil fibers cross (vs 47% = 6% difference)
  - Unequal crossing = unequal tract innervation
    - 53% Tract lesion causes contralateral APD
- Post chiasmal lesion
  - If Visual defect, then homonymous hemianopsia



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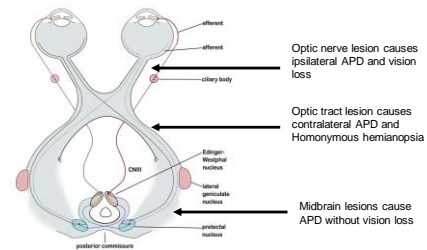
### The most forgotten pretectal afferents

- Lesion as far back as the midbrain
  - Pupil fibers don't synapse until midbrain
    - Presynaptic damage causes APD
  - Pupil fibers have separated from vision fibers
    - Bypass the LGN
    - Therefore no associated vision loss



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### Afferent pupillary defect anywhere along afferent pathway



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## Enough with the Afferents

- On to the Efferents!

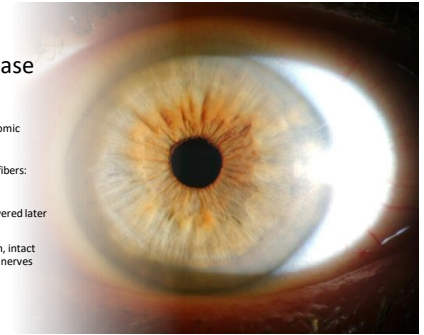


<http://davidwilliams.org.uk/wp-content/uploads/2011/08/fiam-owl-anisocoria-in-light.jpg>

25

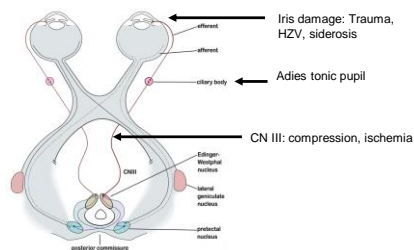
## Efferent disease

- Iris innervated by Autonomic Nervous System
  - Constrictor muscle
    - Parasympathetic fibers: midbrain to pupil
  - Dilator muscle
    - Sympathetics, covered later
- Present with anisocoria
- Patients have good vision, intact retinas and normal optic nerves (no RAPD)



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## Efferent pupillary defect = anisocoria



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## Pupil path is autonomic nervous system

### Autonomics are automatic

- You don't have to think for them to function
- Autonomic nervous system works while you don't

### Components

- Sympathetic nervous system (SNS)
- Parasympathetic nervous system (PNS)

### Balance of power within each system

- Activation (stimulation)
- Suppression (inhibition)

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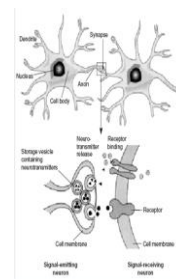
## Components of the ANS



- Sympathetic nervous system
  - Neurotransmitter: epinephrine, norepinephrine
  - Ex.: Fight or flight response
  - Increased heart rate and blood pressure
  - "Wide eyed with fright" - opens pupil and lid
- Parasympathetic nervous system
  - Neurotransmitter: acetylcholine
  - Ex.: Digestion
  - Pupil constriction

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## Neurotransmitter



Chemical released at synapse



Passes the excitation from one nerve to another nerve or muscle



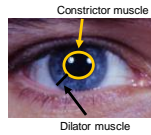
Runners passing baton

[pubs.niaaa.nih.gov](https://pubs.niaaa.nih.gov)

30

Parasympathetics constrict pupil

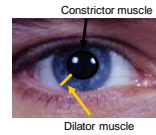
- Sphincter muscle
  - Contraction constricts pupil
  - Purse string effect
- PNS defect = dilated pupil



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Sympathetics dilate pupil

- Dilator muscle- like spokes on wheel
  - Contraction dilates pupil
- SNS defect = small pupil



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### Pupil pharmacology

- Drugs act to stimulate or inhibit receptors
- Ex: dilating drops
  - Sympathetic: stimulator
    - Stimulates dilator contraction
    - Neosynephrine 2.5-10%
  - Parasympathetic: inhibitor
    - Paralyze sphincter contraction
    - Tropicamide 0.5-1%, cyclopentolate, atropine, homatropine, scopolamine

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### Applied science: Locate lesion using anisocoria

- Pinpoint which neuron by pharmacologic testing



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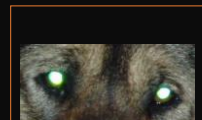
Localize anisocoria by pupil responses: 3 choices

- *Asymmetry equal in light and dark*
  - Asymmetry greater in dark
    - One pupil cannot dilate
  - Asymmetry greater in light
    - One pupil cannot contract

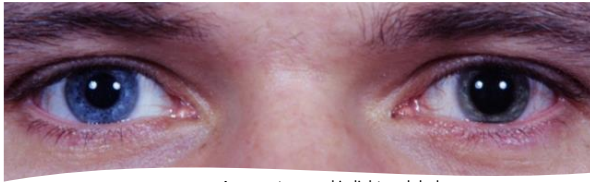
35

### Asymmetry equal in light and dark

- Physiologic or simple anisocoria
- 20% of normal people
- Benign, variable by day
- Example
  - Dark: 5 mm OD, 4 mm OS
  - Light: 4 mm OD, 3 mm OS



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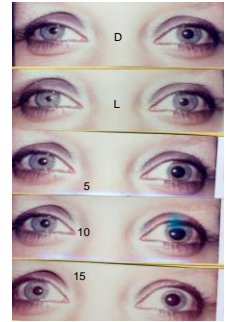
Patient presents with anisocoria: Localize by the pupil responses

- Asymmetry equal in light and dark
  - Physiologic or simple anisocoria
- **Asymmetry greater in dark**
  - **Pupil cannot dilate**
- Asymmetry greater in light

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Asymmetry greater in dark: the little pupil is abnormal

- Pupil cannot dilate
- Dilator not being stimulated (SNS problem)
- Most marked immediately after lights out
- Dilation lag



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### SNS does more than just pupils

- Elevates lid (Mueller's muscle)
- Dilates pupil
- Facial sweating
- Loss of these function = Horner syndrome
  - Ptosis, miosis, anhidrosis



[http://4.bp.blogspot.com/-MgG\\_Xf814TzFbPYFj/AAAAAAAAAAnc/Awthb8NBs16000Horner\\_s\\_syndrome.jpg](http://4.bp.blogspot.com/-MgG_Xf814TzFbPYFj/AAAAAAAAAAnc/Awthb8NBs16000Horner_s_syndrome.jpg)

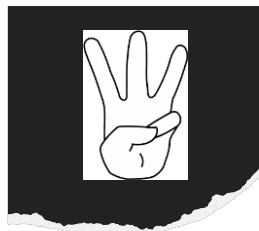
39

Don't forget upside down ptosis



<http://4.bp.blogspot.com/-d018HQzYQI/T-57ScdM-2I/AAAAAAAAAFRIUzILH77q/s1600/P1190013.JPG>  
[https://o.quizlet.com/I2dKCArUaD\\_mwJ7aDEBvEA\\_m.jpg](https://o.quizlet.com/I2dKCArUaD_mwJ7aDEBvEA_m.jpg)

40



41

- First order neuron
  - Hypothalamus, runs down spinal column
  - Synapse in C7-T2 cord

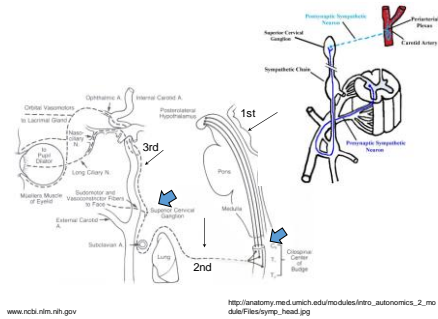
- Second order neuron
  - Leaves spine, ascend outside spine
  - Over lung apex
  - Synapse near jaw
    - Superior cervical ganglion

- Third order neuron
  - Within wall of carotid into skull



[https://o.quizlet.com/FaYbWaAxiwTgNUPQg\\_m.jpg](https://o.quizlet.com/FaYbWaAxiwTgNUPQg_m.jpg)

42



www.ncbi.nlm.nih.gov

http://anatomy.med.umich.edu/modules/intro\_autonomics\_2\_moduleFiles/symp\_head.jpg

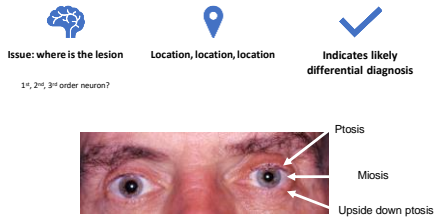
43

## Sympathetic third order neuron

- External carotid- sweat glands of lower face
- Internal carotid- Into skull
  - Cavernous sinus- rides CN VI then CN III
  - In orbit on ciliary nerves
    - Pupil dilator muscle
  - On ophthalmic artery branches
    - Muller's muscle (lid)
    - Lower eyelid retractors
    - Frontal sweat glands

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## Horner syndrome



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## Traditional (multistep) Horner test Step one

- Do not touch or drop the eye!
  - Makes subsequent testing unreliable
- Cocaine 10% (Compounding pharmacy)
  - Prevents synaptic reuptake of norepinephrine
    - Iris dilator muscle
- Excess norepinephrine floods iris dilator receptors
  - Normal pupil dilates
  - \*\*\*If SNS not functioning, no baseline release of norepinephrine so no dilation = Horner syndrome
  - Postcocaine anisocoria > 1mm is Horner

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## Traditional : Step two

- Go home- you've had step one, which makes further same day testing unreliable
- Hydroxyamphetamine 1% (Compounding pharmacy)
  - Stimulates intact nerve to release norepinephrine
  - Released norepinephrine stimulates dilator muscle
    - Pupil dilates
  - If pupil dilates, then 3<sup>rd</sup> order nerve is intact
    - Thus 3<sup>rd</sup> order not the problem
    - Therefore is a 1<sup>st</sup> or 2<sup>nd</sup> order lesion

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## New kid on the block: apraclonidine (lopidine)

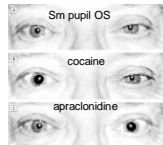
- Iris receptors
  - Alpha 1: dilates
  - Alpha 2: constricts
- Apraclonidine primarily alpha-2 agonist
  - Constricts normal pupils (glare post lasik)
  - Weak alpha-1 activity
- But....Horner syndrome
  - Denervation supersensitivity after 5-7 day

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### Denervation supersensitivity

- Apraclonidine normally alpha-2 agonist
  - Constricts normal pupil
- Horner: denervation supersensitivity ( $\alpha$ -1)
  - Small pupil dilates (alpha-1)
  - Ptotic lid elevates (alpha-1)
- Reversal of anisocoria
  - Easy to obtain drop
  - Easy to read result



**Ocular Effects of Apraclonidine in Horner Syndrome**  
 Jose Morales, MD; Sandra M. Brown, MD; Aziz S. Abdul-Rahim, MD; Craig E. Crosson, PhD  
 Arch Ophthalmol. 2005;118(7):951-954. doi:10.1001/archophth.118.7.951

49



Apraclonidine test (inferior image) confirmed suspected diagnosis of Horner syndrome. González Martín-Moro et al. *Horner Syndrome, a New Complication. J Oral Maxillofac Surg* 2009.

50

### SNS summary

- All you can prove pharmacologically
- It is/not Horner syndrome
- It is/not last nerve in the sympathetic pathway

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30 year old  
WF  
presents  
with 4  
months of  
anisocoria

No PMH, no headache, no neck surgery

6 years s/p bike accident "clothslined"

Seen in ER, arm x-ray and exam (—)

2 years later: left arm, dorsal hand pain, arm "cold"

• Saw chiropractor-resolved

Was noted to have anisocoria

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- Room light (far fixation)
- Light OD
- Dark + 5 seconds
- Dark + 10 seconds
- Dark + 15 seconds

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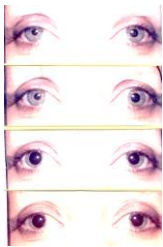
1 hour after cocaine 10%



- Room light
- Dark room
- Mild ptosis, miosis, dilation lag, poor response to cocaine = Horner syndrome

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## Hydroxyamphetamine 1%



• Room light

• Dark room

(45 minutes after HA1%)

• Room light

• Dark room

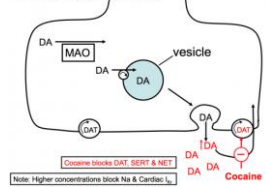
• DX: Preganglionic Horner (brachial plexus trauma)

55

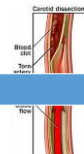
## How to remember the sympathetics?

- People like stimulation
  - Cocaine and amphetamine thus drugs of abuse
  - Stimulation dilates pupil (wide eyed with fright)
- Cocaine is a stimulant and will dilate pupils
  - Inhibits reuptake of neurotransmitter
  - Sympathetic pathway must be intact
- Amphetamine forces release of neurotransmitter if third order neuron is intact

## Cocaine Mechanism



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Where is the "Peril" ?  
3<sup>rd</sup> order neuron lesion

## Carotid artery damage

- Dissection (splitting apart)
- Blood within wall
- Post traumatic
- Roller coaster, whiplash, chiropractic manipulation
- Stroke risk: Carotid occlusion or clot

## Post surgical

- Neck dissection, endarterectomy

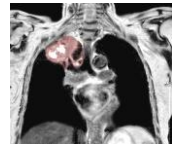
## Cavernous sinus tumor

<http://www.pyroenergy.com/articles/13/images/carotid-artery-dissection.jpg>

57

## Preganglionic "Perils"?

- 2<sup>nd</sup> order neuron lesion
  - Apical lung cancer (Pancoast tumor)
    - Beware Horner in smokers!
  - Metastasis- Sentinel nodes in neck
  - Chest lesion: aortic aneurysms, brachial plexus syndrome, surgery
- 1<sup>st</sup> order neuron lesion
  - Brain and spinal cord- stroke, tumor, disc dx
  - Rarely isolated as is tight space



[https://mefit.org/media/4633/bc\\_pancoast\\_mr.jpg](https://mefit.org/media/4633/bc_pancoast_mr.jpg)

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## Infant with Horner syndrome

- Congenital lesion along the sympathetic chain
- Birth trauma to brachial plexus
- Associated with iris heterochromia
- **Neuroblastoma**
  - Malignant but treatable childhood tumor
  - "Baby gram"- MRI scan of the sympathetic chain
  - Chest lesion



<http://image.slidesharecdn.com/hornerfor3-130619193933-ppapp02/19/horner-syndrome-15-638.jpg?cb=1371672820>

59



Patient presents with anisocoria: Localize by the pupil responses

- Asymmetry equal in light and dark
  - Physiologic or simple anisocoria
- Asymmetry greater in dark
  - Sympathetic N.S. defect
- Asymmetry greater in light
  - Pupil cannot constrict

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Anisocoria greater in light;  
Problem is the dilated pupil

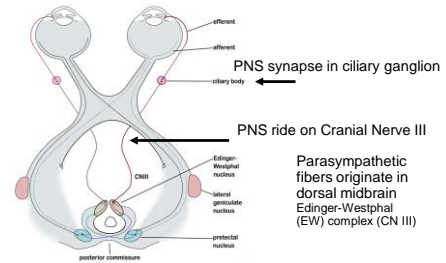
- Pupil can't constrict- big pupil abnormal
  - Sphincter muscle not getting stimulated
    - Nerve defect: parasympathetic pathway
  - Iris muscle damage: slit lamp exam
- Differential diagnosis
  - Pupil involved CN III lesion
  - Adie's tonic pupil
  - Pharmacologic dilation



[www.unhosp.gov/pour/vis/October12007.cfm](http://www.unhosp.gov/pour/vis/October12007.cfm)

61

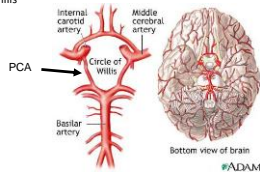
### Parasympathetic pathway



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### PNS lesion: CN III lesion

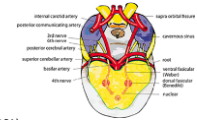
- Ride on Cranial Nerve III
  - Ride on **top** of third nerve
  - Nerve travels **below** posterior communicating artery
    - Circle of Willis



<http://www.nlm.nih.gov/medlineplus/ency/images/pages/18009.htm>

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### CN III "perils"



- PNS Ride on top Cranial Nerve III
  - Under posterior communicating artery (PCA)
    - Aneurysm of the PCA compresses the top of CN III and PNS
  - Enter cavernous sinus
    - Tumor, vascular, inflammatory, or infectious disease
  - Enter orbit on inferior division CN III
    - Tumor, inflammatory or infectious disease

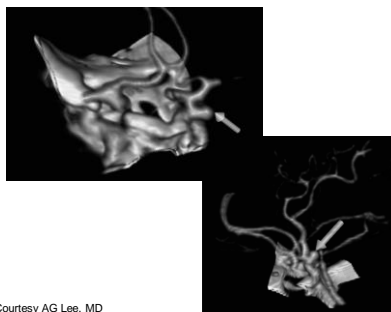


- Synapse in ciliary ganglion in orbit

- Ride on inferior oblique division of CN III
  - Innervates pupil sphincter

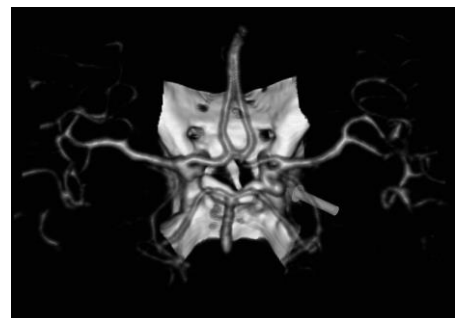
<http://www.cmej.org.za/index.php/cmej/article/viewFile/2686/2905/15666>

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Courtesy AG Lee, MD

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66

### Unilateral dilated pupil: Is it a CN III palsy?



- Ptosis: Partial or complete
  - Need to lift the lid for drops?
    - Stop and reassess
- Exotropia: Partial or complete
  - Cannot adduct, elevate, depress
  - Lateral rectus (CN VI) unopposed



<https://themilewidecenter.files.wordpress.com/2012/07/down-and-out.jpg>

67

### So what?

- Aneurysm of PCA compresses pupil fibers
- Associated with third nerve findings
  - May be partial CN III, partial pupil
- Pupil is key to diagnosis
  - Alternative diagnosis if pupil sparing, complete CN III (ischemic)
- Expanding PCA aneurysm ruptures
  - 50% mortality
  - 50% severe neurologic damage

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### Your role

- If you need to lift the lid to instill drops, Stop!
- Note pupil findings with abnormal motility
- **The** issue in diagnosing a dilated pupil
  - Is this a pupil involved third nerve palsy???
- Life or death encounter



70

### Pupil involved CN III

- MRI/CTA- emergent
- Arteriogram
  - 1% risk of morbidity and mortality
- Neuroradiology/neurosurgery consult
  - Coiling/clipping of aneurysm

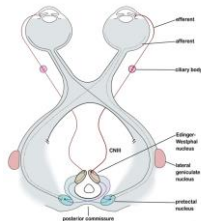


Courtesy of AG Lee, MD

71

### Relax: more benign causes of pupil dilation

- Adie's tonic pupil
  - Ciliary body
- Pharmacologic dilation
- Iris muscle damage



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### Adie's tonic pupil

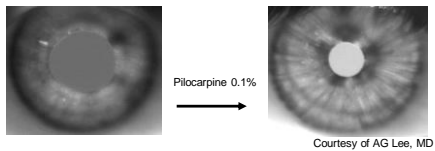
- PNS lesion at the ciliary ganglion
  - Post viral, young female predominance
  - 4% bilateral
- Segmental iris de-innervation
  - Parts of sphincter contract, iris writhes
  - Vermiform movements
- Light-near dissociation
- Iris supersensitivity to neurotransmitter
  - Acetylcholine receptors



73

### Look for vermiform movements

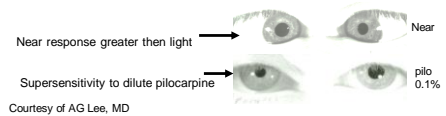
- Infrared pupillometry: segmental transillumination defects of the pupil sphincter



74

### Is the pupil supersensitive

- Has this been there a long time?
- Pilocarpine 1/8% (1/10%)
  - Normal pupil won't react
  - Adie's pupil will constrict



75

### Other causes: Isolated dilated pupil

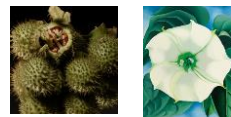
- Pharmacologic
  - Inadvertent contamination
    - Scopolamine patch
    - Naturally occurring alkaloids
      - Jimson weed
      - Angels trumpet
    - Contralateral alpha agonist for glaucoma (Alphagan, lolidine)
  - Intentional dilation
    - Non-organic disease



76

### Is the pupil pharmacologically dilated (had no response to pilo 1/8%)

- Pilocarpine 1%
  - Normal pupil constricts
  - Pharmacologically dilated pupil will not
- Clue: extreme dilation, suspect pharmacologic



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### Iris causes

- Trauma
  - Sphincter rupture- pupil irregular
  - Acute post-traumatic mydriasis
  - Surgical: retinal laser, post cataract surgery
- Inflammation
  - Posterior synechiae
- Iris atrophy
  - Herpetic eye disease
    - Simplex
    - Zoster



Traumatic mydriasis OS

78

### Afferent summary

- Afferent disease: APD
  - Impulse blocked from retina to midbrain
- May have vision loss
  - Ipsilateral loss: large retinal lesion, optic nerve
  - Homonymous hemianopsia: optic tracts- LGN
- May have good vision
  - Even with lesions listed above
  - Lesions posterior to LGN
- Not covered in PERRLA!
  - Must test for afferent pupillary defect (APD)

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## Efferent summary: anisocoria

- Physiologic anisocoria
  - Pupil asymmetry equal in light and dark
- Sympathetic lesion (Horner syndrome)
  - Asymmetry greater in dark
  - Anisocoria > 1 mm after cocaine 10%
  - 3<sup>rd</sup> order neuron (postganglionic) damage
    - No dilation with hydroxyamphetamine 1%
  - Beware with trauma, vasculopathic, or smokers
  - Congenital- evaluate for neuroblastoma

80

## Parasympathetic summary

- Ptosis: Stop!
  - No drops or tonometry
  - If you must lift lid- reassess
- Third nerve palsy
  - Look carefully for partial palsy
  - Dilating aneurysms are at risk for rupture

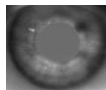


It might be an aneurysm....

81

## Parasympathetics, continued

- Adie's tonic pupil
  - Young women, post viral
  - Vermiform movements
  - 1/8 % pilocarpine supersensitivity
- Parasympathetic mimics
  - Pupil damage: trauma, surgery, inflammation
  - Pharmacologic (prove with pilocarpine 1%)
    - Accidental
    - Intentional



82

Overview:  
Pupil cases

Some things you don't know about things you know well: RAPD (afferent pathway) and Anisocoria (efferent pathway)

Relative afferent pupillary defect and light near dissociation of pupils

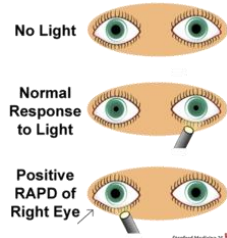
Anisocoria

- Small pupil
- Big pupil

Third nerve palsy, Horner syndrome, Adie tonic pupil, pharmacologic dilation

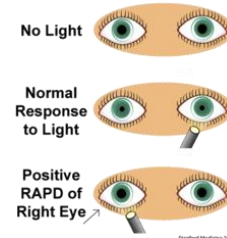
83

Relative afferent pupillary defect (RAPD) OD:  
Which side is the lesion?



84

Relative afferent pupillary defect (RAPD) OD:  
Which pupil dilates with an RAPD OD?



85

How do we check RAPD in an ipsilateral pupil involved third nerve palsy?



<https://www.atlasophthalmology.net/photo.jsf?mode=5830&locale=en>

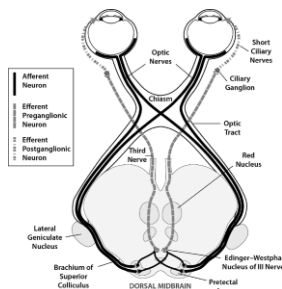
86

## Panel questions

- What would you ask?
- What would you do on exam?
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- Should you admit to hospital?
- What would make you admit?
- What is the treatment and prognosis?

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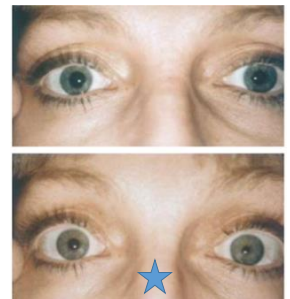
Both pupils



<https://www.cambridge.org/core/books/abs/neurologic-differential-diagnosis/pupil-dilation/ED4F21E059F6CB01FEF4645A5EBD470B>

88

Bilateral light near dissociation



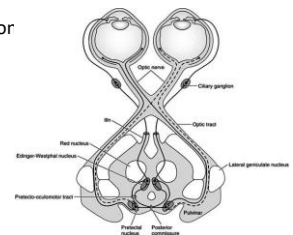
89

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90

Bilateral light near dissociation



<https://www.cambridge.org/core/books/abs/neurologic-differential-diagnosis/pupil-dilation/ED4F21E059F6CB01FEF4645A5EBD470B>

91

"PERRLA" ≠ NORMAL



92

## Panel questions

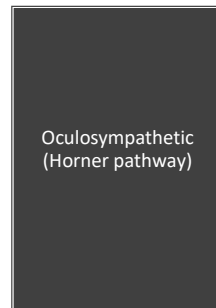
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93

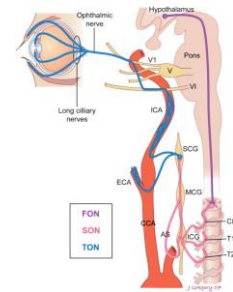


Apraclonidine test (inferior image) confirmed suspected diagnosis of Horner syndrome. González Martín-Mora et al. Horner Syndrome, a New Complication. J Oral Maxillofac Surg 2009.

94



95



<https://radiologykey.com/horners-syndrome-clinical-and-radiographic-evaluation/>

The JAMA Network

Sent for levator dehiscence OS

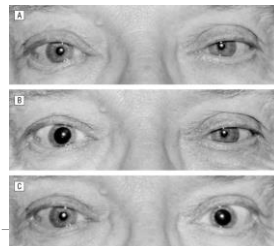


96

The JAMA Network

From: Ocular Effects of Apraclonidine in Horner Syndrome

Arch Ophthalmol. 2000;118(7):951-954. doi:10.1001/archophth.118.7.eos0240



A. Baseline

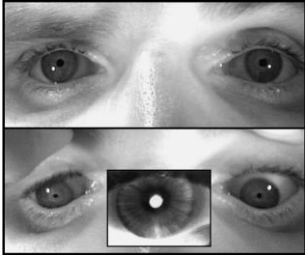
B. Cocaine

C. Apraclonidine

97



Bilateral small to pinpoint without tonic near OU



98

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Pilocarpine 1/10% and pilocarpine 1% do not constrict pupil



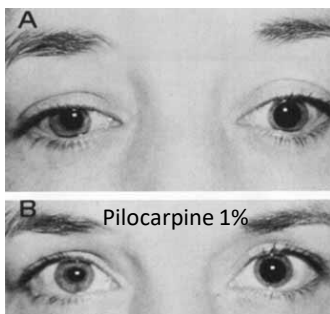
<http://mmcneuro.wordpress.com/2013/02/>

100

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What if....

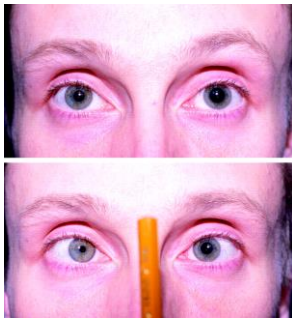


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## Panel questions

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What if....



109

## Panel questions

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## Panel questions

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## Panel questions

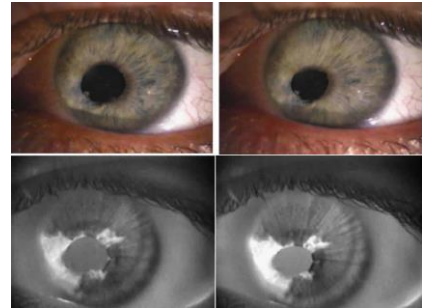
- What would you ask?
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110

What if....



111



112

## Panel questions

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113

What if...



114

## Panel questions

- What would you ask?
- What would you do on exam?
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- What is the treatment and prognosis?

115

Different days



116

## Panel questions

- What would you ask?
- What would you do on exam?
- What tests or imaging would you do and when?
- Should you admit to hospital?
- What would make you admit?
- What is the treatment and prognosis?

117

What if....



118

What if it was non-traumatic and there was a family history of scalloped pupil and amyloid?



119

## Panel questions

- What would you ask?
- What would you do on exam?
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- Should you admit to hospital?
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120

### Summary: Pupil cases

<p>Some things you don't know about things you know well: RAPD (afferent pathway) and Anisocoria (efferent pathway)</p>	<p>Relative afferent pupillary defect and light near dissociation of pupils</p>
<p><b>Anisocoria</b></p> <ul style="list-style-type: none"> <li>• Small pupil</li> <li>• Big pupil</li> </ul>	<p>Third nerve palsy, Horner syndrome, Adie tonic pupil, pharmacologic dilation</p>

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Thanks for your time & attention



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