COURSE TITLE:

TAKING THE MYSTERY OUT OF ABNORMAL PUPILS

Lecturer: Brad Sutton, OD, FAAO
Clinical Professor
IU School of Optometry
Indianapolis Eye Care Center

1

TAKING THE MYSTERY OUT OF ABNORMAL PUPILS

- No financial disclosures
- brsutton@iu.edu

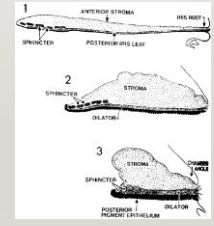
2

•REVIEW OF ANATOMY

- Iris sphincter
- Iris dilator
- Parasympathetic pathway
- Sympathetic pathway

3

IRIS ANATOMY



4

PARASYMPATHETIC PATHWAY

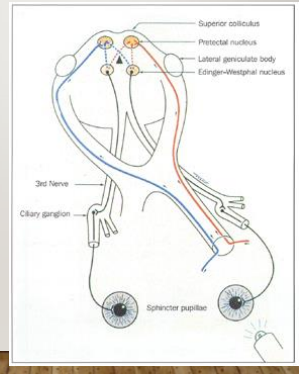
- Light stimulates the retina then impulse travels with the ganglion cells through the chiasm into the optic tracts. 80% go to the LGN , 20% to the pretectal nuclei.They then hemidecussate and terminate at the EW nucleus

5

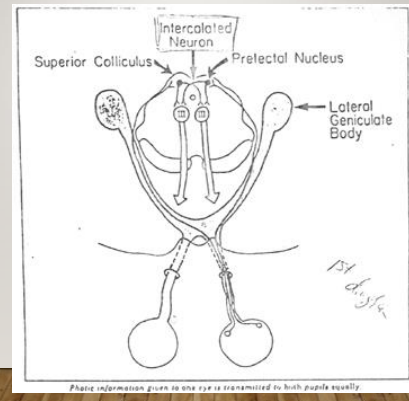
PARASYMPATHETIC PATHWAY

- Four neuron arc
- Retina to the pretectal nucleus in the midbrain (1)
- Pretectal nucleus to the EW nucleus (2)
- EW nucleus to the ciliary ganglion (3)
- Ciliary ganglion to the iris sphincter with short ciliary nerves (4)

6



7



8

POINTS OF INTEREST

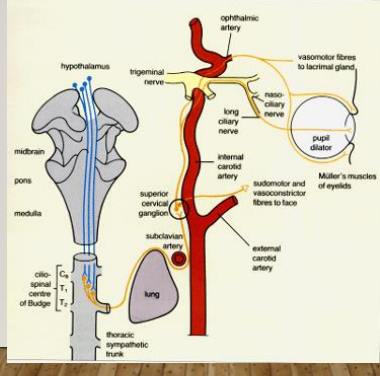
- The third order neuron runs with cranial nerve III from the brain stem to the ciliary ganglion. Superficially located prior to the cavernous sinus.

9

SYMPATHETIC PATHWAY

- Three neuron arc
- Posterior hypothalamus to ciliospinal center of Budge (C8 - T2). (1)
- Center of Budge to the superior cervical ganglion in the neck (2)
- Superior cervical ganglion to the dilator muscle (3)

10



11

POINTS OF INTEREST

- Second order neuron runs along the surface of the lung, can be affected by a Pancoast tumor
- Third order neuron runs with the carotid artery then with the ophthalmic division of cranial nerve V

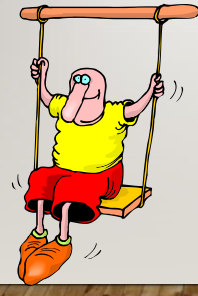
12

TESTING

- APD / reverse APD
- Direct and consensual response
- Which is the abnormal pupil ?
- Very simple rule. Compare in light and dark.
- Is accommodation affected?
- No circumstance where light response is present but near is absent

13

APD TESTING…….AKA……



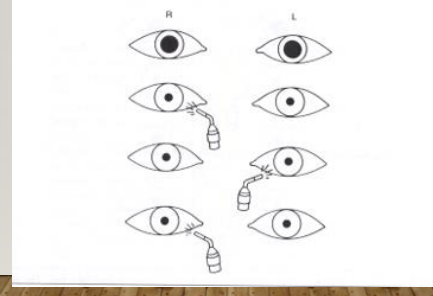
14

QUESTION……

- What happens if one shines a bright light directly (without shining it in the other eye first) in to an eye with an APD?

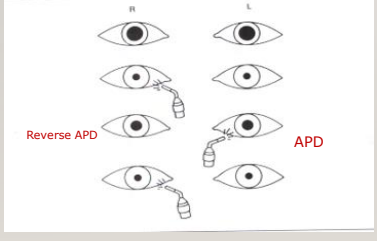
15

NORMAL SWINGING FLASHLIGHT TEST



16

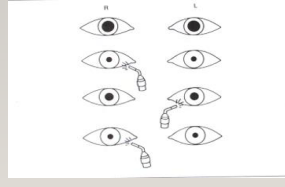
LEFT APD



17

QUESTION…..

- Can patients with a hemianopsia (matching in both eyes) have an APD?



18

HEMIANOPSIA AND APD

- YES!
- Hallmark of optic tract lesions
- APD in the eye with temporal VF loss
- Due to higher percentage of crossed (nasal) than uncrossed (temporal) fibers

19

CAUSES OF PUPIL ABNORMALITIES

- Physiological aneisocoria. Up to 25% of the population. May switch sides and may be transient. Unequal supranuclear inhibition in EW nucleus. Fairly consistent across light levels
- Structural abnormalities and sphincter tears
- Age / ischemia
- Pharmacological agents
- Benign Episodic Pupillary Mydriasis (women who suffer migraines: lasts minutes to one week but usually about 12 hours. May or may not react to light)

20

PHARMACOLOGY

- Visine (usually blue irises with soft contacts in)
- Heroin , morphine , codeine lead to miosis. Dramamine , cocaine , levodopa , and antihistamines lead to mydriasis.
- Plants: Angel's Trumpet, Belladona, Jimson weed, Purple nightshade, Carolina Horsenettle (Datura family of plants abused as hallucinogenics): Contain scopolamine or atropine
- Preparation H!!!!!!! (2.5% phenyl)
- Scopolomine motion sickness patches
- Flea / tick control products
- Qbrexza: A prescription antiperspirant for severe under arm sweating. Anti-cholinergic. Dilates pupil, can affect accommodation

21

MARIJUANA AND PUPIL RESPONSE

- Unclear and not definitive
- THC likely causes constriction
- CBD may cause dilation
- So effect on pupil may depend on composition
- Rebound dilation possible in chronic, heavy users
- Light causes constriction, then pupils show brisk rebound dilation
- Not definitive
- Taught to law enforcement

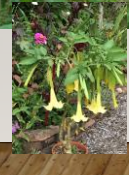
22

PHARMACOLOGY

- 1% pilocarpine test. Will constrict a compressive or tonic pupil but not a pharmacological one (except maybe Visine)

23

ANGEL'S TRUMPET (BRUGMANSIA)



Youtube.com

24

JIMSON WEED (DATURA STRAMONIUM)

Devil's Trumpet

wagwalking.com

Jimson weed

25

PURPLE NIGHTSHADE

Ovlc.com

26

CAROLINA HORSENETTLE (NIGHTSHADE FAMILY)

Wizzley.com

27

BELLADONA ATROPA

Amazon.com

28

PHARMACOLOGY

- Flea and tick sprays / collars / powders
- Some cause mydriasis, some cause miosis!
- Permethrin: found in some sprays and collars. Has sympathetic effects (dilation, normal near vision)
- Anticholinesterase products found in collars, powders, and foggers: heightened parasympathetic effect (miosis, accom. spasm)

29

PERMETHRIN

- Also found in agricultural pesticides and "cow rubs"
- In a scabies treatment: Lyclear, a 5% cream
- Highly toxic to fish and cats (dog collars can kill cats)

30

BAIT (BILATERAL ACUTE IRIS TRANSILLUMINATION) / BADI (ATROPHY / DEPIGMENTATION) SYNDROMES

- Rare!
- Less than 100 reported cases, mostly Turkey and Greece. Often middle-aged women
- Acute loss of iris pigmentation with extensive TID (BAIT only)
- Often increased IOP
- Dilated, poorly reactive pupils
- Most often oral Moxifloxacin, but has been seen with topical Moxifloxacin as well
- May affect the melanin

31

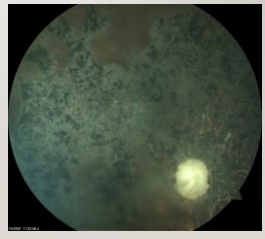
PATHOLOGY / SYNDROMES

- Argyll - Robertson
- Adie's Tonic
- Midbrain lesions
- Horner's
- Third nerve palsy

32

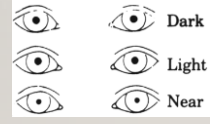
ARGYLL - ROBERTSON

- Bilateral, asymmetrically miotic pupils which are irregular
- Poor dilation with poor response to light but brisk near response
- Hallmark of tertiary neurosyphilis.



33

ARGYLL-ROBERTSON PUPIL



34

ADIE'S TONIC(HOLMES-ADIE)

- Affected pupil larger originally but becomes smaller with time. Originally unilateral but may become bilateral
- Benign lesion of ciliary ganglion resulting in neuronal loss and aberrant regeneration. Affects mostly women in their 20's and 30's
- Often decreased deep tendon reflexes (achilles most common)
- Tendon reflex loss originally on same side as pupil problem-later bilateral. ? Viral etiology

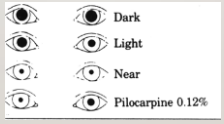
35

ADIE'S TONIC

- Light reaction poor or absent while accommodation is slow and tonic. Can mimic A-R when bilateral and longstanding
- Poor re-dilation after accommodation and vermiform movements are common
- Light / near dissociation possible after some regeneration has occurred (8 weeks)
- Test with 1/8 % pilocarpine. Will constrict while normal pupil will not (studies show that pilocarpine must be diluted to .0625% before there is absolutely no constriction of normal)

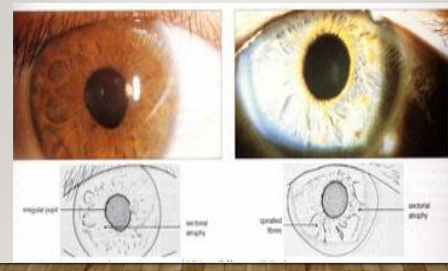
36

ADIE'S TONIC PUPIL (OD)



37

ADIE'S TONIC PUPIL



38

MIDBRAIN LESION

- Affected pupils are larger , often light / near dissociation like A-R pupils. Vertical gaze restrictions, convergence nystagmus on attempted upgaze
- Parinaud's syndrome / Dorsal midbrain syndrome
- Can be caused by a pinealoma, stroke, MS, infection lesion, metastatic lesion, etc.
- Papilledema frequently with pinealoma

39

HORNER'S

- Miosis with normal reaction to light
- Ptosis and upside down ptosis (loss of muscle tone)
- Heterochromia if congenital and anhydrosis if the lesion is below the SC ganglion but before the carotid bifurcation
- Hypotony
- Can occasionally get partial involvement with ptosis only (no miosis)

40

HORNER'S

- Testing ; 4% cocaine will dilate a normal pupil by blocking the re-uptake of epinephrine but will not dilate the Horner's pupil. Shelf life of only six months if preserved and cost of $90
- More practical: 1% lopidine will dilate a Horner's pupil after 30-45 minutes but will not dilate a normal pupil. 0.5% works also. May not work until at least 2 weeks out
- 1% hydroxyamphetamine will dilate a first or second order Horner's but not a third by releasing NE from postganglionic synapses. Must wait one hour to check and need 72-hour washout if cocaine was used
- Ptosis only patients will get lid elevation with Naphazoline. Little pupillary mydriasis.

41

APRACLONIDINE SIDE EFFECTS

- In infants under six months of age…….
- Severe lethargy with bradycardia and decreased respiration
- Several cases reported where hospitalization with oxygen was required
- Avoid use at this age

42

HORNER'S CAUSES

- First order : Neoplasms , Wallenberg's syndrome , trauma , vertebral - basilar insufficiency
- Second order : Pancoast or thyroid tumor , neck trauma or surgery
- Third order : Cluster headaches , cavernous sinus lesion , dissecting carotid aneurysm
- Testing: MRI , MRA , and chest X-ray

43

WALLENBERG'S SYNDROME

- Stroke of vertebral or posterior inferior cerebellar artery in the brainstem

- Difficulty swallowing
- Hoarseness
- Dizziness
- Nausea
- Gait disturbance
- Nystagmus
- Uncontrollable hiccups

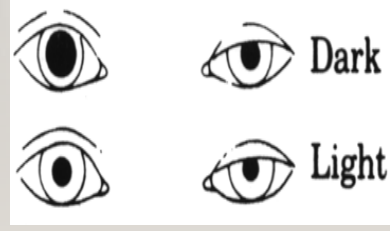
44

RAEDER'S SYNDROME

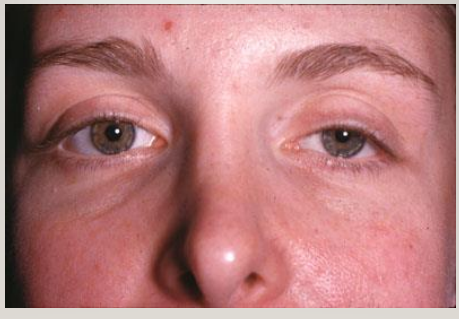
- Horner's with pain in the distribution area of V1. Caused by a neoplasm compressing the trigeminal nerve. Differential for cluster headaches.

45

HORNER'S PUPIL (OS)

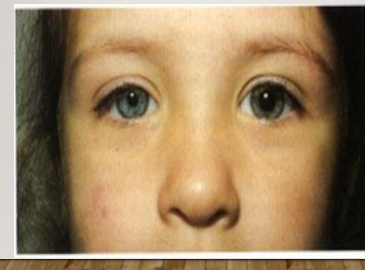


46



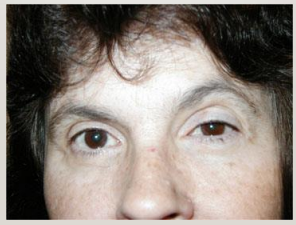
47

HORNER'S PUPIL



48

HORNER'S PUPIL



49

THIRD NERVE PALSY

- Partial vs. Complete. Complete will show fixed , dilated pupil with ptosis and restricted motility. Eye will be down and out and patient will complain of diplopia
- May actually involve only the pupil where fibers are superficial

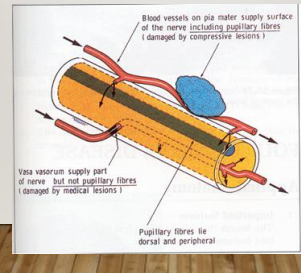
50

PUPIL SPARING / PUPIL INVOLVING

- Rule of thumb : Pupil sparing third nerve palsies tend to be ischemic while those involving the pupil tend to be due to aneurysms or tumors
- Not a firm rule
- Pupil sparing may become pupil involving so follow very closely
- May get pupil involvement only in rare cases such as basilar artery aneurysms

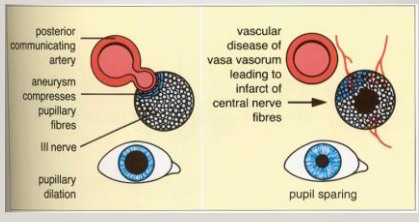
51

PUPIL INVOLVING VS. PUPIL SPARING



52

PUPIL INVOLVING VS. PUPIL SPARING



53

THIRD NERVE MANAGEMENT

- Immediate MRI if any question of aneurysmal involvement. Patient may complain of a severe headache and will often have other neurological signs
- If patient is diabetic or hypertensive and the pupil is not involved, can consider not imaging, but 15-20% who fit this profile will have mass or aneurysm, so may be prudent to scan all

54

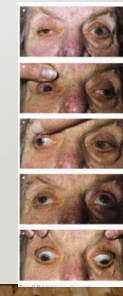
THIRD NERVE MANAGEMENT

- Patient education and reassurance a must
- Diplopia relief with patching
- Most ischemic palsies resolve over several months

55

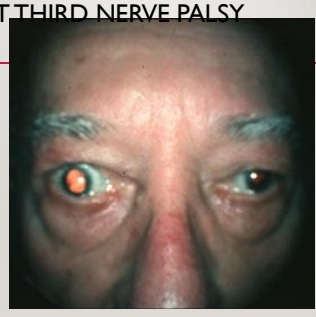
THIRD NERVE PALSY

- Right third nerve palsy

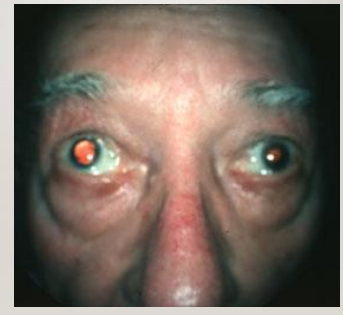


56

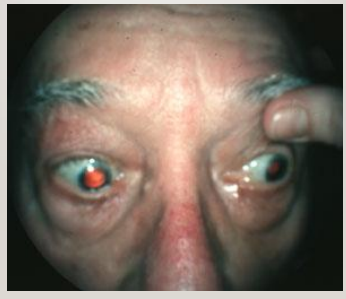
LEFT THIRD NERVE PALSY



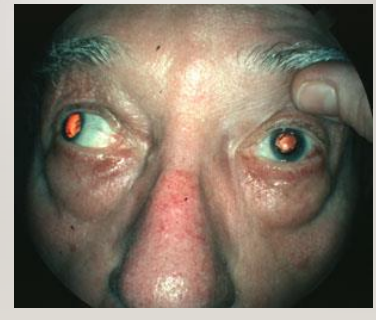
57



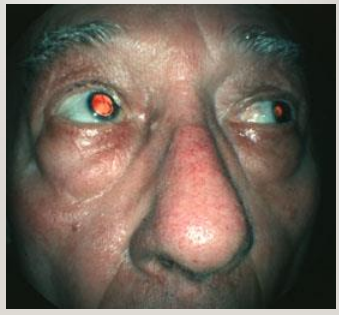
58



59



60



61

SUMMARY

- Abnormally Large Pupil
  - CN III Palsy
  - Acute Adie's tonic pupil
  - Drugs
  - Iris damage
  - B.E.P.M.
- Abnormally Small Pupil
  - Horner's
  - Argyll-Rob.
  - Simple anisocoria
  - Drugs

62