

# NEUROGENIC DIPLOPIA: MANAGING CRANIAL NERVE PALSIES “DOCTOR, I SEE DOUBLE”

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PROFESSOR**



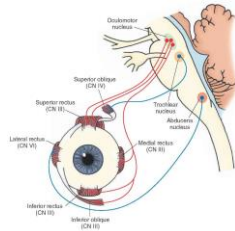
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## OCULAR MOTILITY PROBLEMS

- Non-paralytic strabismus
- Paralytic strabismus (CN III, IV, VI palsy)
- Muscle restriction



## THE 5 QUESTIONS OF DIPLOPIA

1. Is it real?
2. Is the diplopia present monocularly?
3. Is the diplopia horizontal or vertical?
4. Does the diplopia increase in a particular direction of gaze?
5. Is the diplopia greater at distance or near?

**Is the diplopia present  
monocularly?**

## NON-NEUROGENIC ETIOLOGIES

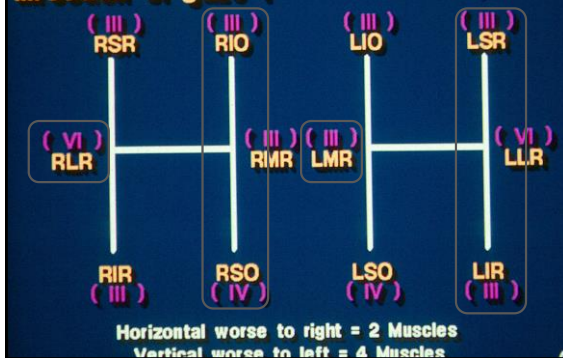
- Keratoconus
- Astigmatism
- Other uncorrected refractive error
- Iridectomy
- Cataract
  - My own personal experience
- Macular edema
- Spectacle lens problems
- Ocular surface disease
- Pinhole cures monocular diplopia!

Is the diplopia horizontal or vertical?

Is the diplopia horizontal or vertical ?



Does the diplopia increase in a particular direction of gaze ?



Is the diplopia greatest at distance or near ?



## PRESENTATION

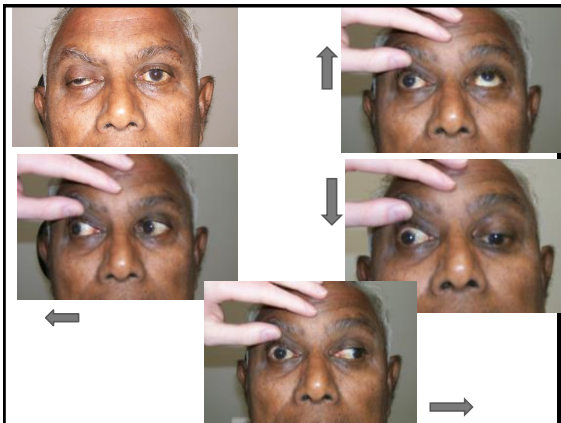
- **Real? Onset?**
  - Acute onset likely vasculopathic – most common – 3 mos duration
- **Course?**
  - Getting better or worse
- **Anything else new?**
- **Isolated - Fellow travelers?**
  - Pupil
  - Lid
  - numbness

WHICH IS BETTER? ONE OR TWO?



**63 YOIM**

- Long standing glaucoma patient
- Sudden onset of orbital pain x 3 days
- + DM; +HTN
- On coumadin
- Pacemaker
- No vision change
- Presents as walk-in emergency glaucoma eval

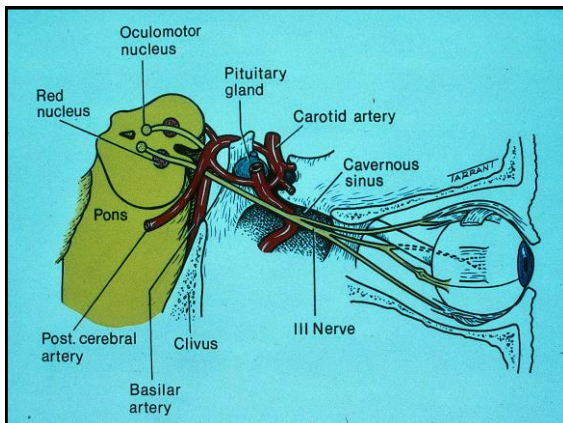
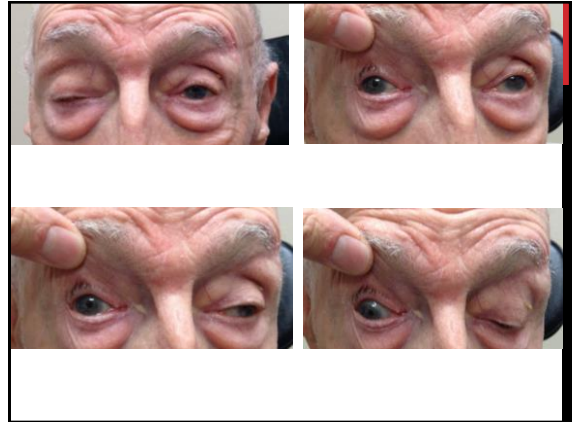
**63 YOIM**

- Pupil involved CN III palsy
- 3 days duration at least
- Most likely cause: intracranial aneurysm
- Sent to ER with detailed notes and recommendations
- Endovascular therapy with coils
- Hospitalized 23 days



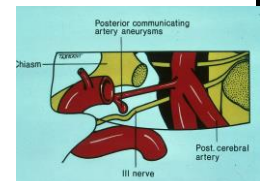
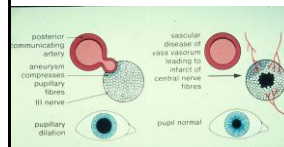
## CN III PALSY CLINICAL PICTURE

- An eye that is down and out with a ptosis
- Adduction, elevation, depression deficits
- Isocoric or anisocoric



## CN III ANATOMY

- **Vulnerable to compression from aneurysm in subarachnoid space**
  - Posterior communicating artery (PCOM)
  - Junction PCOM and ICA
  - Tip of basilar artery



## STILL MORE CLUES

- **A dilated, poorly reactive pupil means compression**
- **Pain can be anything**
  - Aneurysms are always painful
  - Ischemic vasculopathies may be painful ... or not
  - Pain cannot be qualified- only helpful if *not* present
- **A spared pupil does not always rule out aneurysm**
  - Incomplete palsy

## STILL MORE CLUES

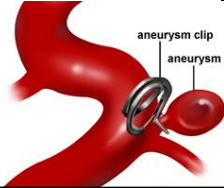
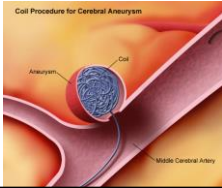


- **Pupil involved CN III palsy is PCOM aneurysm until proven otherwise**
- **Incomplete palsy is PCOM aneurysm until proven otherwise**
  - Regardless of pupil
- **30% of CN III palsy are caused by aneurysm**
- **Vasculopathic CN III will resolve in time**
- **Life threatening posterior communicating aneurysm will rupture in time**

## STILL MORE CLUES

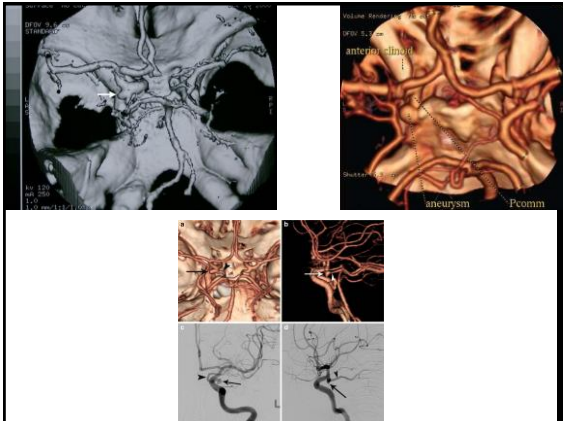
### ⊙ CN III palsy caused by aneurysm

- 20% die within 48 hrs from rupture
- 50% overall die
- Average time from onset to rupture – 29 days
  - 80% rupture w/i 29 days
- Many never make it to hospital



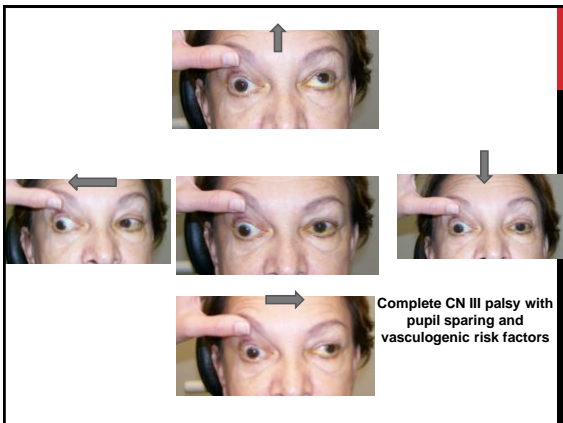
## RULES FOR CN III PALSY IMAGING

- High suspicion of aneurysm: DSA (gold standard)
- CT/CTA is preferred non-invasive imaging for CN III palsy
  - CT for SAH
- CTA requires contrast- renal impairment prefers MRI/MRA
  - Pacemaker, claustrophobia
- CTA superior to MRI when patient can't have MRI
- MRI superior for non-aneurysmal causes (tumor)
  - MRA adds very little time to scan



## A DIFFERENT PATIENT AND PROGNOSIS

- 63 YOF
- Diabetes and HTN
- Sudden onset retro-orbital pain



## WHICH IS BETTER? ONE OR TWO?



Resolves over several weeks



Hospitalized 23 days with 2 neurosurgical procedures

### SUSPECT THE WORST

- Optometrist sees patient with CN III palsy
- Referred to ophthalmologist next day
- Pt dies from SAH before consult

### DOES PRESENCE OF VASCULOPATHIC RISK FACTORS HELP?

- Arteriosclerotic risk factors in elderly favors microvascular etiology but does not rule out aneurysm
- HTN, DM, atherosclerosis, hypercholesterol all common and don't protect against aneurysm
- Answer: **no**, but makes me very nervous when NOT present

### DOES ACUTENESS OF PRESENTATION HELP?

- Ans: **Yes and No**
- Aneurysm expansion usually produces acute manifestations, but chronic and evolving cases well known
- Acute is more worrisome
- Chronic and improving less worrisome but does not rule out aneurysm
- Resolved without recurrence reassuring

### ANEURYSM RISK ASSESSMENT: ISOLATED CN 3 PALSY

- Isolated dilated pupil                      none
- Complete CN3-normal pupil              low
- Partial CN3 – normal pupil              high
- Pupil involved CN3                          **emergency**

### RULE: ISOLATED DILATED PUPIL IS ALMOST NEVER AN ANEURYSM

Ambulatory patients with isolated fixed and dilated pupil unresponsive to light or near more likely to harbor iris or ganglion (Adie's) lesion or medication misadventure than CN 3 palsy

Risk of angiography is much higher than risk of aneurysm in this setting

No imaging needed for isolated dilated pupil



### RUMORS ABOUT BOWIE'S PUPILS

- Dilated from injecting heroin
- Attacked by a gang in hate crime
- Reality: Traumatic anisocoria at age 13 years in fight with best friend George Underwood over a girl!
- Permanently dilated pupil



**RULE**

**Don't neuroimage David Bowie**

**NEVER OUT OF THE WOODS**

- Pt develops CN III palsy from aneurysm
  - Treatment choices: aneurysm clip or endovascular coil packing
- Successfully treated with aneurysm clip
  - All coils are inert and MRI safe; not all clips are MRI safe
- Radiologic tech doesn't verify type of clip
- Pt undergoes F/U MRI with non-MRI safe clip in major medical center
- Clip displaces during MRI
- Patient has fatal hemorrhage during procedure
- Patient survived disease...killed by follow up

**ODE TO A THIRD NERVE**

When the eye is down and out with ptosis,  
 You better hope for miosis.  
 If the palsy is total with pupil sparing,  
 In an Oldie it's vascular and not too daring.  
 A partial palsy calls for double duty,  
 Because it's probably an aneurysm going through puberty.  
 But if the pupil is dilated,  
 An aneurysm has violated.  
 No time for deferral and no time for referral.  
 Send to the ER without debate.  
 Remember, twenty percent will die within the first forty-eight

Joseph Sowka, OD

**35 YEAR OLD MALE**

- Patient referred by GP for emergency evaluation for vertical double vision for past 2 days
- BVA: 20/20 OD, OS
- Pupils: normal (-) RAPD
- Perimetry: normal OD, OS
- Motility: Right hyper deviation which worsens in left gaze and right head tilt.
- Medical Hx: Normal, but has worst case of sinusitis ever – began 1 week before double vision.
- DX: Right CN IV palsy

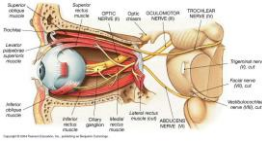
**CN IV PALSY: THREE CARDINAL QUESTIONS:**

- Which eye is higher in primary gaze?
- Does the hyper deviation worsen in right or left gaze?
- Does the hyper deviation worsen with right or left head tilt?
- CN IV Palsy: A hyper deviation in primary gaze which is greater in opposite gaze and ipsilateral head tilt
- Vertical diplopia is CN IV palsy until proven otherwise
  - And if it isn't CN IV palsy, then it is a skew deviation- supination testing



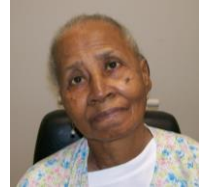
## CN IV ANATOMY

- Exits the midbrain posteriorly and decussates
- Longest course
- Travels around tentorium, through cavernous sinus, through SOF
- Most prone to trauma



## CN IV PALSY

- Longstanding CN IV palsy may present with diplopia from decompensation
  - Observe old photos for head tilt (*Facebook Tomography*)
- Rule of 40-30-20-10



## CN IV MANAGEMENT

- Isolated, non-traumatic:**
  - Evaluate for ischemic diseases
  - Non-ischemic causes of non-traumatic, isolated CN IV palsy rare
  - Look for longstanding decompensation
    - Increased vertical vergences
    - Old photos

## 35 YEAR OLD BLACK MALE

- What are the possible etiologies?
  - MG, MS, ischemia, syphilis, Lyme, Sarcoid
- What is the likely etiology?
  - Erosion of inflammation from adjacent sinus
- Outcome?
  - Resolution commensurate with sinus infection

## ODE TO VERTICAL DIPLOPIA

When your patient sees double up and down,

Its rarely a cause to frown.

Look for a tilt and prove its old,

And remember vertical vergences will be bold.

It's a fourth until proven otherwise.

Trauma, congenital, and idiopathic you should surmise.

But if its not a fourth and its new,

Lay them back because its probably a skew.

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## 37 YEAR OLD WHITE MALE

- CC: Sudden onset painful horizontal diplopia x 6 days- Worse at distance and right gaze
- Medical Hx: reportedly normal
  - Evaluated at ER: CBC and CT scan (non-contrast) - normal
- Social Hx : Smoker (1 PPD); recovering alcoholic
- BVA: 20/20 OD, OS
- Motility: Right ABduction deficit
- Pupils: normal (-) RAPD
- Forced duction test: Negative
- BP: 144/102



### 37 YEAR OLD WHITE MALE

- Diagnosis: Right vasculogenic CN VI palsy secondary to undiagnosed hypertension.
- Further imaging: not ordered at this time
- OD patched during diplopic period; ophthalmoplegia disappeared within 12 weeks.

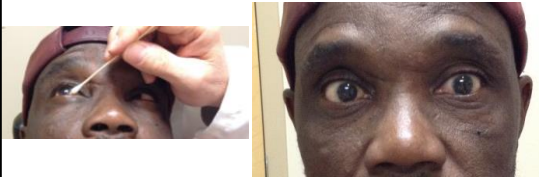
### CN VI PALSY

- Hallmark sign is horizontal diplopia, greater at distance, with an abduction deficit



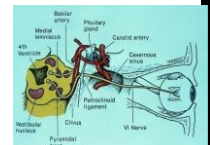
### CN VI PALSY

- Check motilities at distance
- Forced duction testing



### MORE ABOUT MASS LESIONS

- CN VI is stretched against the clivus
- CN VI palsy common in ICP rises/mass lesions/ PTC
- Bilateral CN VI palsy and disc edema is indicative of mass lesions and increased intracranial pressure

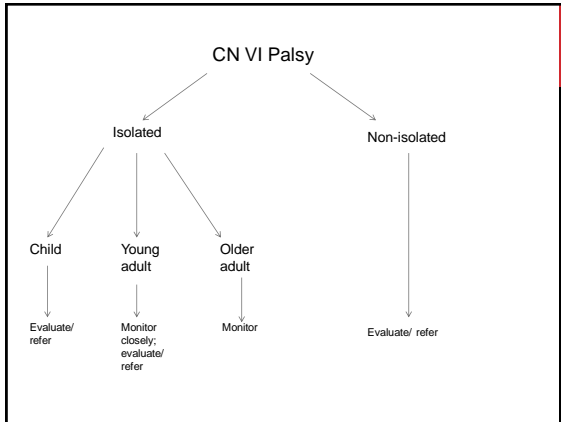


### CN VI MANAGEMENT

- Each case of CN VI palsy should be classified as traumatic or non-traumatic.
- Non-traumatic cases should be subdivided as neurologically isolated (just CN VI palsy) or non-neurologically isolated (something else).
- Additionally, patients should be ascribed to one of 3 groups: children, young adults, and older adults

### CN VI DEMOGRAPHIC GROUPS

- **Older adults** (usually not bad)
  - Vascular disease common- resolves-3mos
    - Consider GCA over 60 yrs
- **Children** (may be bad)
  - Presumed viral illness, trauma, malignancy (50%)
- **Young adults** (usually bad)
  - Vascular disease (4%) and idiopathic (13%) uncommon
  - Usually complicated CN VI palsy (hemiparesis, Horner syndrome, facial paresis)
    - Cerebrovascular accidents involving the pons, aneurysm (typically within the cavernous sinus) or neoplasm (33%-cavernous sinus, pons), MS (24%).



## CN VI PALSY IN OLDER ADULTS

- In cases of isolated CN VI palsy in older adults with a history of diabetes or hypertension, neuroimaging and other extensive evaluation can be deferred, unless the palsy progresses, fails to improve over 3 months, or other neurologic complications develop.
- Ischemic vascular palsies typically progress over several days, but progression over two weeks warrants neuroimaging.

## ODE TO A SIXTH

When the double is side by side,  
And abduction does not abide.  
Prove it's a sixth with a forced duction test,  
Eliminate muscle, thyroid and all the rest.  
In kids and young adults it's a worry.  
Get a scan and you better hurry.  
But in an Oldie you're practically free.  
Prescribe a patch and check to see its better  
in three.

Joseph Sowka, OD

## CRANIAL NERVE PALSY CHEAT SHEET

- Horizontal diplopia = CN VI
  - MR palsy?
    - No: INO; entrapment, MG
- Nearly all CN III will get some form of imaging
- Vertical diplopia = CN IV (or SKEW)
  - Nobody does forced duction for vertical diplopia
  - CN III palsy doesn't cause just vertical diplopia

## CRANIAL NERVE PALSY CHEAT SHEET

- Vasculopathic risk factors (diabetes, hypertension, hypercholesterolemia, coronary artery disease, myocardial infarction, stroke, and smoking) significantly associated with presumed microvascular cause

Tamhankar MA, Blouisse V, Ying GS, et al. Isolated Third, Fourth, and Sixth Cranial Nerve Palsies from Presumed Microvascular versus Other Causes: A Prospective Study. Ophthalmology. 2013 Jun 6

## CRANIAL NERVE PALSY CHEAT SHEET

- Vasculopathic risk factors were also present in 61% of patients with other causes
  - Just because pt is older and has risk factors doesn't mean they can't have something else
- In patients with vasculopathic risk factors only, with no other significant medical condition, 10% were found to have other causes, including midbrain infarction, neoplasms, inflammation, pituitary apoplexy, and GCA

Tamhankar MA, Blouisse V, Ying GS, et al. Isolated Third, Fourth, and Sixth Cranial Nerve Palsies from Presumed Microvascular versus Other Causes: A Prospective Study. Ophthalmology. 2013 Jun 6

## CRANIAL NERVE PALSY CHEAT SHEET

- By excluding patients with third cranial nerve palsies and those with GCA, the incidence of other causes for isolated fourth and sixth cranial nerve palsies was 4.7%

Tamhankar MA, Biousse V, Ying GS, et al. Isolated Third, Fourth, and Sixth Cranial Nerve Palsies from Presumed Microvascular versus Other Causes: A Prospective Study. Ophthalmology. 2013 Jun 6

## CRANIAL NERVE PALSY CHEAT SHEET

- Patients with acute isolated ocular motor nerve palsies can have other causes, including neoplasm, GCA, and brain stem infarction.
- Brain MRI and laboratory workup have a role in the initial evaluation of older patients with isolated acute ocular motor nerve palsies regardless of whether vascular risk factors are present

Tamhankar MA, Biousse V, Ying GS, et al. Isolated Third, Fourth, and Sixth Cranial Nerve Palsies from Presumed Microvascular versus Other Causes: A Prospective Study. Ophthalmology. 2013 Jun 6

## CRANIAL NERVE PALSY CHEAT SHEET

- Contrast enhanced brain MRI has an important role in the evaluation of patients with acute isolated ocular motor mononeuropathies, even in patients over age 50 with vasculopathic risk factors.
- ESR, CRP and acetylcholine receptor antibody assay should also be considered

Tamhankar MA, Biousse V, Ying GS, et al. Isolated Third, Fourth, and Sixth Cranial Nerve Palsies from Presumed Microvascular versus Other Causes: A Prospective Study. Ophthalmology. 2013 Jun 6

## FINAL PALSY RULES

- Sudden onset palsies are typically vasculopathic... but could be something else
  - Check lipids, FBS, BP – internist
  - F/u 2-6 weeks looking for improvement
- Imaging isolated complete palsies?
  - Yes- definitely under age 50
- Not isolated – scan
- Arteriosclerotic palsies the most common

## FINAL RULE

- Ischemic microvascular palsies are allowed to get worse over 1 week and be no better at 2 weeks, but are not allowed to get worse over 2 weeks.

May all your palsies be isolated



LIVE LONG AND PROSPER

