Neuro Op Grand Rounds: Fields and Diplopia

South Dakota Optometric Association
September 2017
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Disclosures
• I have received honorarium from the following:
  • Alcon
  • Allergan
  • CE in Italy
  • Heidelberg Engineering
  • Review of Optometry

Course Goals
• Take something back to clinic that you can use
  • Inform
  • Interesting
  • Maybe see something in neuro

Key Areas of Investigation for Field Loss
1. Pre chiasmal
2. Chiasmal
3. Post chiasmal

Pre Chiasmal Field Loss
• Is always* unilateral
• Unilateral field loss is restricted to the
  • Globe
  • Retina
  • Optic nerve head
  • Optic nerve to the chiasm
• Exception* is very posterior optic nerve lesion just at anterior chiasm
• Contralateral nasal fibers after decussation enter the posterior portion of fellow ON

Chiasmal Field Loss
• Is always bilateral
• May be asymmetric
• Is either
  • Bitemporal
  • Binasal
• Medial optic chiasm = pituitary & 3rd vent
• Lateral optic chiasm = carotids and cavernous sinus
Chiasmal Field Loss

- If medial optic chiasm affected
  - Bitemporal field loss
  - Pituitary most likely, possibly 3rd vent
    - Above/below field defects
- If lateral chiasm affected
  - Binasal field defect
  - Carotid artery, cavernous sinus most likely

Patient JR - Vision Loss OS

- 80 y/o white female
- Post Crystalens OD and OS
- History AMD OU
- Constant complaints of vision OS not as good as expected post implantation
- VA 20/30  20/80
- Fundus unchanged

When things just don’t add up

- That is a fact of medicine.
- Sometimes things just don’t always add up.
- Patient in no acute distress, nothing imminently going on.
- Repeat studies, but don’t wait too long
1 month later

- Complaints of vision out to left side no better, maybe worse
- VA 20/30 20/200 PHNI OD, OS, OU
- Pupils ERLA (-) APD
- EOM's intact OU
- AT 16, 18
- Anterior segment: NL OU

3rd Fields Post LE IOL

HFP Fields

Post Chiasmal Field Loss

- Is always bilateral
- Field loss is in left or right hemifield
  - Homonymous
- Field loss is opposite the side of the lesion
  - If VF loss more inferior, then parietal lobe
  - If VF loss more superior, then temporal lobe

Post Chiasmal Field Loss

- Lesion closer to the chiasm
  - Incongruous
- Lesion closer to occipital cortex
  - Congruous
Post Chiasmal Field Loss

- Very congruous above and below, macular sparing
- Occipital pole
- Cuneus
  - Above calcarine fissure
  - Inferior (L/R) homonymous quadrantanopsia
- Lingula
  - Below calcarine fissure
  - Superior (L/R) Homonymous quadrantanopsia

Where’s the lesion?

- Suspect pituitary origin

Where’s the lesion?

- Chiasmal likelihood; lateral aspect

Where’s the Lesion?

- Fixation involved, denser above than below, incongruous right sided defect
- Left optic radiations, more temporal lobe than parietal; not at occipital pole

Anatomy

- CNS / Visual-motor pathways
- Appearance of key structures

Planes of the body
M. Buonarroti
- 1475-1564
- Painter, sculptor, architect, engineer
- An accomplished anatomist, at time when forbidden
- Michelangelo

Don’t Mess with Mike

• When the Pope’s own Master of Ceremonies Biagio da Cesena said “it was mostly disgraceful that in so sacred a place there should have been depicted all those nude figures, exposing themselves so shamefully, and that it was no work for a papal chapel but rather for the public baths and taverns,” Michelangelo worked da Cesena’s semblance into the scene as Minos, judge of the underworld. It is said that when he complained to the Pope, the pontiff responded that his jurisdiction did not extend to hell, so the portrait would have to remain.
Coronal (Frontal) suture

Planes of the body
“Front/back”

Sagittal suture
Planes of the body
“Left/right”

Midsagittal
Planes of the body
“Top and Bottom”

Tissues have different molecular structure; and they “image” differently

We can understand that if we look at the “inside” and “outside” of the brain

Gray matter and White matter
And there are different imaging techniques

**Gray matter (cell bodies)**

**White matter**

The cerebrospinal fluid system

Cortex (gray)  White matter on inside

**Ventricles with cerebrospinal fluid**

Numerous sections include the cerebrospinal fluid system

Fluid is in stark contrast to brain, etc... and it doesn't always have to image black.
... there are different imaging techniques
-not only can gray/white matter "image" differently
-so can cerebrospinal fluid

Cerebrospinal fluid
is also found OUTSIDE the brain

Cerebrospinal fluid (CSF)

Pia and Arachnoid

Pia/arachnoid

Cerebrospinal fluid fills subarachnoid space — can see it on imaging — one of the reasons that MRI images brain so well

Ex: Calcarine fissure

Mid sagittal

Mid sagittal

Anatomical wet specimen

Calcarine fissure
All cranial nerves traverse the subarachnoid space (Cerebrospinal Fluid) and can be damaged there.

For example, Cranial nerve IV (superior oblique) is especially at risk in the ambient cistern (subarachnoid space).

“THE FIRST 4 QUESTIONS”

1. WHO IS THE NEURO-OP ON CALL?
2. WHAT IS THEIR NUMBER?
3. HOW SOON CAN THE PATIENT BE SEEN?
4. WHAT DID THEY HAVE?
“THE FOUR QUESTIONS”

1. DOUBLE VISION WHEN COVER EITHER EYE?
2. “UP & DOWN” OR “SIDE BY SIDE”?
3. WORSE IN WHICH DIRECTION?
4. GREATER AT DISTANCE OR NEAR?

4 Questions We Should Ask

1. Is Double Vision Present with one eye covered?
   • “Yes” eliminates neurologic etiologies
   • “No” may be a ‘windows’ problem
   • Media opacities
   • Monocular diplopia

2. Does the Diplopia have a vertical component or a horizontal component

3. In which direction (R or L) does the diplopia worsen?

4 Questions We Should Ask

• 3-In which direction (R or L) does the diplopia worsen?
4 Questions We Should Ask

- Is the diplopia greater at distance or near?

Clinical Assessment of Diplopia

- Begins with dissociating the presenting images before each eye
  - Maddox Rod

"LANGUAGE OF THE LIGHT"

(PATIENT’S VIEW)
Fourth Nerve Palsies

4th N Innervation & Motility

- Innervation is easy:
  - Superior Oblique

- Motility is more complex:
  - Both a horizontal AND vertical component
  - AND…… a TORSIONAL component

4th N Palsy

- The paretic eye is hyper in primary gaze
- The diplopia decreases on same gaze; increases on opposite gaze
- But……..
Torsional Obliques

• Remember this:
  • SUPERIOR muscles INTORT
  • INFERIOR muscles EXTORT

4th N and SO Muscle

• The SO is primarily an INTORTER
  • Compensating for a faulty intorter, one would TILT your head in the opposite direction

4th Nerve Palsies

• 4th N innervates only the superior oblique
• Only CN to exit brain dorsally
• Diplopia will then be both horizontal and vertical
• Dinner diplopia
• Head tilt to the opposite side
• Congenital or aquired
  • Aquired adults: trauma
  • Aquired children: ominous sign if no trauma
• May be unilateral or bilateral

Etiology of Adult Superior Oblique Palsies
(Mollan SP, et al. Eye 2009)

• N = 150
• 133 unilateral-
   isolated:
  • 38% congenital
  • 29% trauma
  • 23% vasculopathic
  • 7% undetermined
• 10 bilateral:
  • 50% trauma
  • 20% tumor
  • 20% undetermined

4th nerve palsies

• 40, 30, 20, 10 rule of ADULT 4th N palsy
  • 40% Trauma
  • 30% Idiopathic
  • 20% Vasculopathic
  • 10% Tumor / Aneurysm
• Due to congestion at the orbital apex, very unusual location to have an isolated 4th N palsy

Third Nerve Palsies
THIRD NERVE PALSIES
KEY POINTS

- MOTILITY SIGNATURE
- ANATOMICAL “ROADMAP”
- ABERRANT REGENERATION
- PUPIL, PAIN, PARESIS

Third Nerve Palsies

- CN III Innervates:
  - SR
  - IR
  - MR
  - IO
  - Levator
  - Parasympathetic Iris (constrictor)

So What is Presentation

- Go back to the Physiological H
- Assuming a RIGHT CN III Palsy:

EOM ACTIONS

1. HORIZONTAL & VERTICAL
2. > ACROSS FROM VERTICALLY LIMITED EYE
3. DISTANCE & NEAR

IS THIS REALLY A CN IIIrd?
ANSWER BY DIPLOPIA

EOM ACTIONS
THE SIGNATURE OF CN III PARESIS

• Hyper deviation which increases in upgaze and reverses in downgaze

• Exodeviation increases across from the vertically limited eye
CN III Palsies

- Damage in subarachnoid space results in isolated CN 3 palsy that manifests as:
  - Diplopia
  - Ptosis
  - Dilated pupil
- Usually caused by aneurysm at junction of posterior communicating artery and ICA
- Vascular CN III are pupil sparing, usually

3rd N. Pupils

Vasonervorum

EOM Fibers

Pupil Fibers

PCA

CN III

Aneurysm
“Rule of the Pupil”


THREE QUESTIONS
CN III PALSY

• IS THIS A CNIII PALSY?
• IS IT AN ISOLATED CNIIIrd?
• IF IT IS AN ISOLATED CNIIIrd, WHAT DO I DO?

Nucleus of CN III

Edinger-Westphal Nuclei

Cavernous Sinus

Contents

Orbital Apex

Internal carotid artery (and carotid sympathetic plexus)
Non Isolated CN III Palsies

• Damage to CN III in the orbital apex, superior orbital fissure, or cavernous sinus result in unilateral CN III paresis, but often with ipsilateral CN 4 or 6 involvement
• Etiology in these cases is:
  • Metastatic Dz
  • Sphenoid wing meningioma
  • Pituitary abnormalities
  • Zoster
  • Carotid A aneurysm in Cavernous sinus

ABERRANT REGENERATION OF CN III

1. PSEUDO GRAEFE SIGN
2. EYELID SYNKINESIA
3. LIGHT-GAZE DISASSOCIATED PUPILS
ABERRANT REGENERATION OF CN III

- **COMMON CAUSES:**
  - ANEURYSM, TUMOR, TRAUMA
- **UNUSUAL:**
  - INFECTION/INFLAMMATION
- **NEVER:** DIABETES MELLITUS

THREE QUESTIONS
CN III PALSY

- **IS THIS A CNIII PALSY?**
- **IS IT AN ISOLATED CNIIIrd?**
- **IF IT IS AN ISOLATED CNIIIrd, WHAT DO I DO?**

ISOLATED IIIrd in KIDS

- **CONGENITAL** 44%
- **TRAUMA** 16%
- **INFLAMATION** 11%
- **MISCELLANEOUS** 11%
  - NEOPLASM 10%
  - ANEURYSM 3%
  - ISCHEMIA 3%

LOOK FOR ABERRANT REGENERATION!

Neuroimaging for CNIII Palsy

- **Intra-arterial DSA**
- **CT Angiography**
- **MR Angiography**

CN VI Palsies

- CN VI innervates only the lateral rectus
- Diplopia is strictly horizontal and patient has esotropia
- Diplopia increases in horizontal gaze toward the paralytic muscle
- Often associated with HTN or DM
Motility Pattern

- Inability to Abduct, therefore paretic eye has eso posture IN PRIMARY GAZE
- Eso increases on gaze TOWARD paretic eye

Compensation for CN VI Palsy

- Since the paretic eye cannot Abduct and is eso, the patient will TURN THEIR HEAD to the SAME side

CN VI Palsies

- CN VI has a long climb up the clivus and is prone to compression here.
- Increased ICP will compress both CN VI’s in the sub arachnoid space and result in bilateral VI paresis
  - These folks need imaging
  - Often have bilateral papilledema

27 y/o AA Woman

- c/o horizontal diplopia (right gaze > left)
- h/o recurrent headaches (am > pm)
- BVA:
  - 20/20 OD
  - 20/20 OS
S/P Surgical Decompression

Etiology of CN VI Palsy
Mayo Clinic Study of Olmstead Co. MN USA from 1978-1992 (n = 137)

- Undetermined: 26%
- Hypertension: 19%
- HTN & diabetes: 12%
- Trauma: 12%
- MS: 7%
- Neoplasm: 5% (complicated)
- Diabetes (alone): 4%
- CVA: 4%
- s/p neurosurgery: 3%
- Aneurysm: 2% (complicated)
- Other: 8%


Non Isolated CN VI Palsies

- If CN VII involved with a VI palsy, lesion is in brainstem at pons as VI and VII nuclei are next door neighbors
  - Stroke in adults
  - Demyelination in 20-40 year olds

Non Isolated CN VI Palsies

- If CN IV and or III involved, lesion in cavernous sinus
  - Metastasis, aneurysm, CCF, zoster

Cavernous Sinus Contents

Thank You!