Evaluation of the Patient with Diplopia

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Objectives
- Review of anatomy
  - Extraocular muscles
  - CN III, IV and VI
- Causes of diplopia
  - Central segment
  - Cisternal segment
  - Cavernous sinus segment
  - (Intraorbital segment)
- Imaging protocol

Diplopia
- Simultaneous perception of two images of a single object that is slightly displaced in relation to each other

Diplopia
- Loss of coordination of extraocular muscles
- Dysconjugate gaze
- Two separate visual inputs

Anatomy – Extraocular muscles
- Medial rectus m.
- Lateral rectus m.
- Superior rectus m.
- Inferior rectus m.

Anatomy – Extraocular muscles
- Superior oblique m
- Inferior oblique m.
**Anatomy – Extraocular m. innervation**

- Superior oblique m. → CN IV
- Lateral rectus m. → CN VI
- Inferior oblique m.
- Superior rectus m.
- Inferior rectus m.
- Medial rectus m.
- (Levator palpebrae m.) → CN III

**Anatomy – Cranial nerve III, IV & VI**

Oculomotor N. (III)
Trochlear N. (IV)
Abducens N. (VI)

**Anatomy – Cranial nerve III**

- Multiple nuclei in posterior midbrain
- Motor component
- Parasympathetic component from Edinger-Westphal nucleus → pupillary reflex

**Anatomy – Cranial nerve III**

Topographic alignment of fibers
- Superior compression → abnormal pupillary reflex

All rectus muscles except lateral
Inferior oblique
Levator palpebrae superiors
Optic nerve, papilla and ciliary muscles
Pathology – Cranial nerve III palsy

Pathology – Cranial nerve III

- Central segment: Acute infarction at CN III nucleus and exit zone

Pathology – Cranial nerve III

- Central segment: Vascular compression

Pathology – Cranial nerve III

- Cisternal segment: Vascular compression

Pathology – Cranial nerve III

- Cisternal segment: Posterior communicating artery aneurysm

Pathology – Cranial nerve III

- Cisternal segment: Uncal herniation
Pathology – Cranial nerve III

- Cisternal & cavernous segments: Neuritis

Pathology – Cranial nerve III

- Cisternal & cavernous segments: Lymphoma

Pathology – Cranial nerve III

- Cavernous segment: Cavernous sinus cyst

Summary: Cranial nerve III

- ALWAYS look for aneurysms => MRA or CTA required

Anatomy – Cranial nerve IV

- Paired nuclei at inferior colliculus
- Fibers decussate within midbrain => Contra versus ipsilateral superior oblique muscle
- DORSAL origin
Anatomy – Cranial nerve IV

Pathology – Cranial nerve IV palsy
- Dysconjugate gaze best seen in tilted head position

Pathology – Cranial nerve IV
- Central segment: Traumatic contusion

Pathology – Cranial nerve IV
- Central segment: Low grade glioma

Pathology – Cranial nerve IV
- Central segment: Traumatic contusion

Trauma = most common cause of CN IV palsy!
**Pathology – Cranial nerve IV**
- Central segment: Cavernoma
  - T2
  - T1
  - T2* GRE

**Pathology – Cranial nerve IV**
- Cisternal segment: Schwannoma
  - T2
  - GdT1
  - T2

**Pathology – Cranial nerve IV**
- Cisternal segment: Epidermoid tumor
  - T2
  - GdT1
  - DWI

**Summary: Cranial nerve IV**
- Exits the midbrain from posteriorly!
- Extremely small ⇒ usually not seen when normal
- Check for atrophy of the superior oblique muscle to determine chronicity of lesion
- Trauma = most common cause of CN IV palsy!

**Anatomy – Cranial nerve VI**
- Nucleus in lower pons at facial colliculus
- Fibers track anteriorly to exit at ponto-medullary junction
- Internal genu of facial nerve drapes around CN VI nucleus
**Anatomy – Cranial nerve VI**

⇒ Affixed at the Dorello’s canal
⇒ Only nerve within in the cavernous sinus

**Pathology – Cranial nerve VI palsy**

**Pathology – Cranial nerve VI**

⇒ Central segment: Acute infarction

⇒ CN VI palsy is often a/w facial nerve palsy and vice versa

**Pathology – Cranial nerve VI**

⇒ Central segment: Multiple sclerosis
**Pathology – Cranial nerve VI**

- **Cisternal segment: Retroclival epidural hematoma**

- **Petros apex segment: Metastasis**

- **Cavernous segment: ICA aneurysm**

**Summary: Cranial nerve VI**

- Often associated with facial nerve palsy in case of pontine lesions
- Affixed at the petrous apex!
- Only CN within the cavernous sinus
- May be affected by ICA aneurysms
Anatomy – Ophthalmoplegia

- Multiple ocular cranial nerve deficits
- Lesions most commonly located in cavernous sinus or orbital apex

Pathology – Ophthalmoplegia

- Cavernous segment: Sarcoidosis

Pathology – Ophthalmoplegia

- Cavernous segment: Lymphoma

Pathology – Ophthalmoplegia

- Orbital apex: Aspergillosis

Pathology – Ophthalmoplegia

- Orbital apex: Metastasis
Summary: Ophthalmoplegia

- Cavernous sinus and orbital apex = most common lesion locations
  - Always evaluate the fat pad within orbital apex
  - Always perform a set of non-fat suppressed T1 images in axial and coronal plane
- Search for additional abnormalities on current study or other studies to narrow differential diagnosis

Imaging protocol

- Thin section images (≤ 3mm) are required
  - Image from the anterior orbit through brainstem in coronal plane
  - Image from top of the orbit to inferior medulla in axial plane
- Volumetric, heavy T2 weighted images
  - For cisternal segments of the cranial nerves
  - Utilize multiplanar reformations for best display
- Always perform MRA or CTA in search of aneurysms
- Always include FLAIR and DWI through brain

Approach to causes of diplopia

- Single versus multiple cranial nerve involvement?
- Additional neurological symptoms?
- Differential diagnostic considerations based on:
  - Lesion acuity
  - Lesion location
  - Lesion imaging appearance
  - Additional findings

Helps in localization of lesion