EXPERT DIFFERENTIAL DIAGNOSIS:
Ventricles and Choroid Plexus

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DISCLOSURE:
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ExpDDx:
Ventricles, Choroid Plexus

- Gross, imaging anatomy
- ExpDDxs, general organization
  - Anatomy-based
  - Generic imaging patterns
  - Modality-specific imaging findings
- Each ExpDDx has entities grouped as:
  - Common
  - Less common
  - Rare but important
VENTRICLES

• Four cavities
  • CSF-filled
  • Ependyma-lined
• Connected by
  • Foramen of Monro
  • Cerebral aqueduct
• Contain choroid plexus
• Communicate with SAS via
  • Midline foramen of Magendie
  • Lateral foramina of Luschka
**CHOROID PLEXUS**

- **Embryonic tela choroidea**
  - Invaginates along choroidal fissures
  - Choroid plexus forms where contacts ventricular ependyma
- **Contains secretory epithelium**
  - Produces CSF
  - CSF exits foramina of Luschka, Magendie
  - Resorbed through arachnoid granulations
VENTRICLES/CHOROID PLEXUS:
Anatomically-based Differentials

• Ventricles, Normal Variants
• Choroid Plexus Lesions
• Ependymal/Subependymal Lesions
• Lateral Ventricle Mass
• Thick Septum Pellucidum
• Foramen of Monro Mass
• Third Ventricle Mass, General
• Cerebral Aqueduct/Periaqueductal Lesion
• Fourth Ventricle Mass
VENTRICLES, NORMAL VARIANTS

• **Common**
  - Asymmetric lateral ventricles
  - CSF pulsation artifacts
  - Cavum septi pellucidi +/- vergae
  - Coarctation of anterior horns

• **Less Common**
  - Connatal cysts
  - Germinolytic cysts

• **Rare but important**
  - Open inferior 4th ventricle (Blake pouch)
ASYMMETRIC LATERAL VENTRICLES

- Normal variant
- Usually asymptomatic
- Lateral common
- SP “pushed” to smaller ventricle
- Brain normal
- Helpful
  - FLAIR
  - Thin section T2WIs
  - FIESTA
  - CSF flow study
CSF PULSATION ARTIFACT

Case #1

Case #2

FLAIR  
T1WI

FLAIR  
T1C+
CHOROID PLEXUS LESIONS

- **Common**
  - Choroid plexus cyst
  - Enlarged choroid plexus

- **Less common**
  - Choroid plexus papilloma
  - Meningioma
  - Metastasis
  - Ventriculitis/plexitis
  - Neurocutaneous syndromes (SWS, NF-2)

- **Rare but important**
  - Choroid plexus carcinoma
  - Lipoma
  - Langerhans cell histiocytosis
CHOROID PLEXUS CYSTS

- Common, normal
  - 40-50% prevalence
  - Incidental finding
  - Bilateral
- Older patients
- Xanthogranulomas
- Imaging
  - Variable signal
  - Variable enhancement
  - May “restrict” on DWI!
ENLARGED CHOROID PLEXUS

- Normal fetus
  - May be giant!
- Trisomy 18 or 21
- ↑ Collateral venous drainage
  - Sturge-Weber
  - Cortical venous or dural sinus occlusion
CHOROID PLEXUS PAPILLOMA: Typical, Atypical

- Child, usually <5
- Lobulated, intraventricular
  - Atrium lateral v.
  - 4th ventricle
  - Less common = 3rd ventricle, CPA
- Typical = WHO I
- Atypical = WHO II

(Images of brain scans for WHO I and WHO II)
MENINGIOMA, METASTASIS, ETC.

Meningioma

Metastasis

Plexitis/Ventriculitis

NF-2
RARE BUT IMPORTANT

CP carcinoma

Lipoma

Neurosarcoid

LCH
LATERAL VENTRICLE MASS

- **Common**
  - Choroid plexus cyst
  - Hemorrhage (germinal matrix, trauma)
  - *Neurocysticercosis*
- **Less common**
  - Choroid plexus papilloma
  - Meningioma
  - Metastasis
  - SGCA
  - *Central neurocytoma*
  - Subependymoma
  - Neurosarcoid
  - *Ependymal cyst*
- **Rare but important**
  - Choroid plexus carcinoma
  - *Ependymoma*
  - *Cavernous malformation*
  - Lymphoma
  - Astrocytoma
  - LCH
  - Epidermoid cyst
  - Teratoma
LATERAL VENTRICLE MASS: Helpful Hints for Differential Diagnosis

• Specific sublocation
  • Septum pellucidum/foramen of Monro (SGCA, subependymoma, etc.)
  • Body (neurocytoma, NCC, etc.)
  • Choroid plexus (CPP, meningioma, metastasis, cavernous malformation, etc.)

• Patient age
• History (trauma, infection, etc.)
• Imaging (CSF-like, enhancement)
NEUROCYSTICERCOSIS

- SAS > parenchyma > ventricles
- Lateral > 4th > 3rd ventricle
- Imaging depends on stage
- Helpful imaging hints
  - FLAIR best
  - T1C+
  - Consider NECT (for Ca++)
SUBEPENDYMAL GIANT CELL ASTROCYTOMA

- **Only** in T.S.C.
  - 15% of patients
- **Imaging**
  - Enhancing mass
  - Frontal horn
  - Attached to septum
  - *Any* enhancing SEN here must be followed
  - 50-70% Ca++
- **Look for other T.S. stigmata**
CENTRAL NEUROCYTOMA

- <1% of all tumors
  - But half of intraventricular tumors 20-40y
- “Bubbly” mass
- Body > frontal horn of lateral v.
  - Attached to septum pellucidum
  - Circumscribed, lobulated mass
  - WHO grade II
- Strong but heterogeneous enhancement
SUBEPENDYMOMA

- Rare
  - Benign, well-differentiated intraventricular tumor
  - 4th v > lateral > 3rd ventricle
  - Lateral v: Attached to septum pellucidum/lateral wall
  - Often incidental finding
  - Middle-aged, older patients

- Imaging
  - T2 hyperintense
  - Variable enhancement
EPENDYMAL CYST

- Benign, thin-walled intraventricular cyst
  - Ependymal-lined
  - Lateral > 4\textsuperscript{th} v.
  - Atrium > > body, temporal horn
- Imaging
  - CSF-like
  - Displaces choroid plexus
  - Nonenhancing
CAVERNOUS MALFORMATION

- Pathology
  - Endothelial-lined “caverns”
  - Intralesional hemorrhages
  - Rare in ventricles (glomus)

- Variable imaging
  - “Popcorn” ball (Zabramski II)
  - Fluid-fluid levels
  - Hemosiderin rim
MISCELLANEOUS LATERAL VENTRICLE MASSES

Metastasis

Neurosarcoid

Teratoma
FORAMEN OF MONRO: Anatomy
## FORAMEN OF MONRO MASS

### Common
- CSF flow artifact
- Cavum septi pellucidi
- Colloid cyst

### Less common
- Neurocysticercosis
- TSC with SEN
- SGCA
- Metastasis
- Astrocytoma

### Rare but important
- Subependymoma
- Central neurocytoma
- Germinoma
- VBD

- Choroid plexus papilloma
- Choroid plexus cyst
- Cavernous malformation
- Ependymal cyst
- Alexander disease
COLLOID CYST

- **Pathology**
  - Endodermal cyst (like neurenteric, Rathke)
  - Simple epithelium with mucinous secretions

- **Imaging appearance almost pathognomonic**
  - Wedged into foramen of Monro
  - +/- obstructive hydrocephalus

- **Most common mistaken “lesion” = CSF flow artifact**

- **Other**
  - NCC cyst
  - Neoplasm (typically enhance)
    - Subependymoma
    - Choroid Plexus Papilloma
COLLOID CYST VS. FLOW ARTIFACT

- **CSF flow**
  - Look for phase artifact
  - Multiplanar technique
  - Typically in 3rd v, not foramen of Monro
  - Fornix, ICVs appear normal

- **Colloid cyst**
  - Hyperdense on NECT
  - Fornix straddles, draped around cyst
  - Wedged into foramen of Monro
  - Displaces ICVs, fornices
MISCELLANEOUS FORAMEN OF MONRO MASSES

VBD

GERMINOMA

METASTASIS

ASTROCYTOMA
THIRD VENTRICLE MASS, GENERAL

- **Common**
  - Flow artifact
  - Massa intermedia (normal)
  - Colloid cyst
- **Less common**
  - Germinoma
  - Neurocysticercosis
  - Neurosarcoid
  - Chiari 2 (prominent massa intermedia)
  - Vertebrobasilar dolichoectasia (mimic)
- **Rare but important**
  - Choroid plexus papilloma
  - Craniopharyngioma
  - Pituitary macroadenoma
  - Tuber cinereum hamartoma
  - Chordoid glioma
  - Lymphoma
  - LCH
  - Ependymoma
VERTEBROBASILAR DOLICOECTASIA

Case #1

Case #2

NECT

CECT
TUBER CINEREUM HAMARTOMA

• Hypothalamic hamartoma
  • Congenital mass of heterotopic GM
  • Usually pedunculated
  • Between infundibulum, mammillary bodies
  • Less common = sessile mass
  • Clinical = isosexual precocious puberty, gelastic seizures

• Imaging
  • >90% solid, like GM
  • Occasionally slightly hyperintense
  • Nonenhancing
  • Rare: Cysts, Ca++
CHORDOID GLIOMA, THIRD VENTRICLE

• Pathology
  • Newly described (WHO, 2007)
  • Rare; slowly growing, noninvasive
  • 3rd ventricle, adults
  • Epitheloid GFAP+ cells in variably mucinous stroma

• Imaging
  • Bulky, well-delineated
  • Hyperintense to brain on T2, FLAIR
  • Strong, uniform enhancement

Courtesy C. Glastonbury
MISCELLANEOUS THIRD VENTRICLE MASSES

CPP

Ependymoma

NCC

Germinoma
ALTERNATIVE APPROACH TO THIRD VENTRICLE MASSES: Age-Based

- **Adult**
  - Pseudomass (flow artifact, VBD)
  - Colloid cyst
  - NCC
  - Neurosarcoid
  - Macroadenoma
  - Chordoid glioma

- **Child**
  - Germinoma
  - Choroid plexus papilloma
  - Craniopharyngioma
  - TC hamartoma
  - LCH
FOURTH VENTRICLE:
Normal Anatomy
FOURTH VENTRICLE MASS

• **Common**
  - Medulloblastoma (PNET-MB)
  - Ependymoma
  - Pilocytic astrocytoma

• **Less common**
  - Subependymoma
  - Choroid plexus papilloma
  - Neurocysticercosis
  - Epidermoid cyst
  - Hemangioblastoma
  - Metastasis
  - Atypical teratoid-rhabdoid

• **Rare but important**
  - “Trapped” 4th v
  - Ependymal cyst
  - Dermoid cyst
  - Lipoma
  - Rosette-forming glioneuronal tumor
MEDULLOBLASTOMA (PNET-MB)

• Pathology
  • Arises from 4th roof or vermis
  • Small round blue cells
  • 50% early CSF dissemination

• Imaging
  • Hyperdense on NECT
  • Solid mass; looks like “round ball” stuck in 4th v
  • Enhances (solid typical)
  • Often restricts on DWI!!
EPENDYMOMA

- **Pathology**
  - 2/3 posterior fossa
  - Arises from 4th v floor

- **Imaging**
  - “Toothpaste” or “plastic” tumor
  - Squeezes through Luschka, Magendie
  - Intratumoral cysts, hemorrhage common
  - Heterogeneously enhancing
SUBEPENDYMOMA

- **Pathology**
  - Benign, slow-growing
  - Middle-aged, older adults
  - Inferior 4th v or obex > frontal horn
  - Often incidental (autopsy, imaging)

- **Imaging**
  - Well-delineated, lobular
  - T2 hyperintense
  - Variable enhancement (none to mild)
EPIDERMOID, DERMOID CYSTS

• **Epidermoid**
  - Congenital inclusion cyst
  - 15-20% 4th v
  - “Scalloped,” CSF-like
  - Except hyperintense on PD, FLAIR, restricts on DWI

• **Dermoid**
  - Like fat
  - Look for evidence of rupture
ATYPICAL TERATOID RHABDOID TUMOR (ATRT)

- 50% infratentorial
- Most patients < 3y
- Large, bulky mass
- Cysts, hemorrhage common
- Inhomogeneous enhancement
- May mimic medulloblastoma!
ROSETTE-FORMING GLIONEURONAL TUMOR

- First case 1998
- 11 cases 2002
- WHO recognized 2007
- Young adults
- Pathology
  - Two components: Neurocytic, astrocytic
  - Rosettes, perivascular “pseudorosettes”
  - WHO grade I tumor

Courtesy M. Thurnher
RGNTs

Courtesy M. Thurnher
FOURTH VENTRICLE
MASS:
Age-Based DDx

- **Child (common)**
  - Medulloblastoma
  - Ependymoma
  - Pilocytic astrocytoma
  - ATRT

- **Adult (rare)**
  - Metastasis
  - CPP
  - Subependymoma
  - Hemangioblastoma
  - RGNT

- **All ages**
  - NCC
  - Epidermoid
  - Dermoid
  - Trapped 4th v
SUMMARY

• Location, location, location!!
  • Which ventricle?
  • Is mass in choroid plexus?
• Patient age