Posterior Fossa Masses
Differential Diagnosis

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Disclosures

- No financial disclosures nor conflict of interest to report

I’m from the Government ...
... and I here to help!
Uniformed Services University

- Military Medical School
  - Just like the service academies
- 16th largest SOM in the US
- 165 students in each class
  - Army
  - Navy
  - Air Force
  - Public Health Service
  - Indian Health Service
The Best Dressed Medical Students

BDU – Camouflage Uniforms ...

A More Recent Photo ...

Uniformed Services University of the Health Sciences
Neuroradiology is like Real-estate

Three Rules of Neuroradiology:

LOCATION LOCATION LOCATION

LOCATION LOCATION LOCATION
PATTERN ANALYSIS

Basic Approach

- Where is the lesion?
  - Intraaxial
  - Extraaxial
  - Intraventricular

- Where is the lesion?
  - Supratentorial
  - Infratentorial

- How old is the patient?
  - Child
  - Adult

- What about Sex?
PATTERN ANALYSIS: Location

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PATTERN ANALYSIS:

INTRA-AXIAL:

- Cortex
- Gray-white Junction
- Deep White Matter
- Deep Gray Matter

- Glioma
- Medulloblastoma
- Hemangioblastoma
- Metastases
- Infarct / Hematoma
- Avm / Congenital
- Abscess/inflammation
EXTRA-AXIAL LESIONS:

- Subarachnoid
- Subdural
- Epidural
- Calvarium (Skull Base)
- Subgaleal
- Scalp (Soft-tissues)

- Meningioma
- Pituitary Adenoma
- Craniopharyngioma
- Schwannoma
- Chordoma
- Dermoid / Epidermoid, Cyst, Lipoma
- Hematoma, Metastasis, Infection

Basic Approach

Imaging Modality (with/without contrast)

Normal

Abnormal

Location?

List of Suspects

Profile For Each Suspect
List of Suspects

Infratentorial

We are here!

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CLASSIC LOCATIONS

- Foramen magnum
- Cerebellopontine angle
- Fourth ventricle/Cerebellum
- Sella/parasellar/suprasellar
- Basal ganglia/Third ventricle
- Lateral ventricle/Pineal region
- Deep hemispheric/periventricular
- Cortical and subcortical
- Convexity Extraaxial

Posterior Fossa Lesions

- Extraaxial – Cerebellopontine Angle
  - Schwannoma
  - Meningioma
  - Epidermoid Inclusion Cyst
- Intraaxial – Cerebellum
  - Pilocytic Astrocytoma
  - Medulloblastoma
  - Ependymoma
  - Hemangioblastoma
- Intraaxial – Pons
  - Astrocytoma
Posterior Fossa Masses

Extraaxial:
- Schwannoma
- Meningioma
- Epidermoid

Pontine Astrocytoma
Ependymoma
Medulloblastoma

Pilocytic astrocytoma
Hemangioblastoma

History:
24 y.o. woman with headache

Exam:
N/A
Differential Diagnosis?

Vestibular Schwannoma
Ependymoma
Diffuse Pontine Astrocytoma
Vestibular Schwannoma
Pilocytic Astrocytoma
DDx Can be difficult …

- Medulloblastoma
- Ependymoma

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- Medulloblastoma
- Ependymoma
**DDx Can be difficult ...**

- **Medulloblastoma**
- **Ependymoma**
History:
24 y.o. woman with headache

Exam:
N/A

Findings:
Brain MRI (T1W, T2W, T1W+C) demonstrate multiple enhancing lesions; there are bilateral enhancing lesions in the internal auditory canals; there is an enhancing lesion within the right lateral ventricle; there are multiple enhancing lesions along the falx.

Differential:
• Multiple Schwannomas
• Multiple meningiomas
• NF-2
• Metastatic disease
• Olfactory (I)
• Optic (II)
• Oculomotor (III)
• Trochlear (IV)
• Trigeminal (V)
• Abducens (V)
• Facial (VII)
• Vestibulocochlear (VIII)

Internal Auditory Canal

Bill's Bar – vertical crest

Ant

7 SV
C IV

Pos

crista falciformis

8th

Cochlear
Sup. Vestibular
Inf. Vestibular

7 is UP
Coch(lear) is Down
CPA MASSES Differential

- Schwannoma (8th >> > 5th)
- Aneurysm, arachnoid cyst
- Meningioma, mets
- Epidermoid, ependymoma, CPP
CPA MASSES Demographics

- 7/9 (Schwannoma, 8th > > 5th)
- 1/9 Meningioma (tentorial/petrous)
- 1/9 "Other":
  - Epidermoid Cyst (1/18)
  - Mets, aneurysm, etc.
  - Glioma (ependymoma, CPP)
  - Arachnoid cyst
  - Cystadenoma of endolymphatic sac
  - Glomus tumor

Vestibular Schwannoma: Inf > Sup

- IAC origin
  - IAC involved
  - IAC Enlarged (70%)
- Spherical Mass
  - encapsulated
- Heterogeneous if large
  - > 20 mm
- Enhance “always”
Intracanalicular Schwannoma

Schwannoma begin inside or distal to IAC

Cisternal Segment – CNS Oligodendrocytes
IAC Segment – PNS Schwann cells
SCHWANNOMA

- 5-10% of All CNS Tumors
- Benign, Slowly growing
- F > M (Intracranial), M > F (Spinal)
- 30's - 60's, w/NF, 2-10's - 30's
- Sensory Nerves (usually):
  - CNN VIII (Inf. Vestibular), V, X
  - Spine: Dorsal Roots
- Majority (>90%) are Sporadic
- Multiple in NF-2, Bilat.VIII Pathognomonic

Bilateral Vestibular Schwannoma

Laryngoscope. 2007;117(12):2087-92. Data show IVN tumors twice as common as SVN, Bedside (caloric) tests sup. vest.

From Laszlo Mechtler, DNI
NF2 Bilateral \textbf{Vestibular} Schwannoma

Arch Otolaryngol Head Neck Surg. 1986 Feb;112(2):190-4 "A review of histologic and surgical literature demonstrates that the earlier estimate is inaccurate, and that only 50\% of vestibular schwannomas originate on the superior branch of the vestibular nerve."

Laryngoscope. 2007;117(12):2087-92. Data show \textbf{IVN tumors twice as common as SVN}, Bedside (caloric) tests sup. vest. nerve

J Laryngol Otol. 2008 Feb;122(2):128-31 \textbf{Inferior vestibular nerve in 139 cases (91.4 per cent)}, from the superior vestibular nerve in nine cases (6 per cent), from the cochlear nerve in two cases (1.3 per cent) and from the facial nerve in two cases (1.3 per cent).

IAC and CPA Mass Lesion
Vestibular Schwannoma
Young Schwannoma – Old Schwannoma

Benign Cystic Degeneration
Trigeminal Schwannoma

Courtesy of Jacqueline A. Bello MD

Meckel's Cave

Trigeminal Schwannoma

Courtesy Jacqueline A. Bello MD
NF2 – Multiple Schwannomas, two 8th and one 5th

From Laszlo Mechtler, DNI

Meningioma

- Tentorium or Dura
- IAC Normal Size
- Hemispherical
- Homogeneous
- Enhance Homogeneously
- Hyperostosis 15-40%
- Dural Tail 70-90%

Courtesy of Bob Peyster, MD
Tentorial Meningioma

Hyperostosis
Meningioma

HYPEROSTOSIS

Does Not Enhance

Wavy or Undulating Margin
Epidermoid - CPA

Not exactly isointense to CSF

DWI - bright:
Restricted Diffusion + T2 “shine through”
CPA Epidermoid – “pearly tumor”

Squamous epithelium, Layers of keratin debris – like onion skin

Epidermoid - Dry Keratin
Epidermoid - Dry Keratin
## Epidermoid vs. Arachnoid Cyst

<table>
<thead>
<tr>
<th>Epidermoid Cyst</th>
<th>Arachnoid Cyst</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPA most common</td>
<td>Middle fossa common</td>
</tr>
<tr>
<td>Extraaxial CPA Lesion</td>
<td>Extraaxial CPA Lesion</td>
</tr>
<tr>
<td>IAC Normal</td>
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</tr>
<tr>
<td><strong>Undulating Margin</strong></td>
<td><strong>Rounded Bubble Mass</strong></td>
</tr>
<tr>
<td>Similar to CSF - but NOT Identical</td>
<td>Identical to H2O on CT and all MR sequences</td>
</tr>
<tr>
<td>- Brighter on PD, FLAIR, DWI, Darker on ADC</td>
<td>- T1, PD, T2, FLAIR, DWI, ADC</td>
</tr>
<tr>
<td>NO Enhancement</td>
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</tr>
<tr>
<td><strong>Wispy internal layers</strong></td>
<td>NO Internal ‘structure’</td>
</tr>
</tbody>
</table>

### Arachnoid Cyst – Convex Bubble

**NOTE:** Signal higher in cyst, due to less dephasing from CSF pulsation.
CLASSIC LOCATIONS

- Foramen magnum
- Cerebellopontine angle
- Fourth ventricle/Cerebellum
- Sella/parasellar/suprasellar
- Basal ganglia/Third ventricle
- Lateral ventricle/Pineal region
- Deep hemispheric/periventricular
- Cortical and subcortical
- Convexity Extraaxial
Location of Neoplasms

% of Brain Tumors

Supratentorial

Infratentorial

Age

5 10 15 20 25 30 35

ADULT - CEREBELLAR/IVth

- Metastasis
- Hemangioblastoma
- Hemorrhage, infarct
- Glioma
  - Ependymoma
  - Astrocytoma
- Abscess
Central Posterior Fossa Mass

- Could be Intraaxial
- Could be Intraventricular
  - Could be extending from vermis into ventricle
  - Could be extending from ventricle into vermis
Fourth Ventricle - Schematic

Tentorium

Straight Sinus

Clivus

Occiput

Ant/Sup vellum

BS

Post/Inf medullary vellum
Fourth Ventricle – Medullo (PNET)

Fourth Ventricle – Ependymoma