Head and Neck

Imaging Anatomy
Class Objectives

Careful preparation for and participation in this activity will enable the student to
to describe the basic principles of plain radiography, computed tomography, magnetic resonance imaging and ultrasound.

[7823]
to label anatomic structures in the head and neck as seen on cross-sectional imaging studies.

[7824]
to select the imaging modality best suited for optimal visualization of the paranasal sinuses, the spinal cord, the salivary glands, the cervical spine, the thyroid gland, the carotid arteries and the lymph nodes of the cervical area.

[7825]
Websites

• http://www.lumen.luc.edu/lumen/MedEd/grossanatomy/cross_section/vhphead/vhphead.html
• http://www.szote.u-szeged.hu/Radiology/Anatomy/
I. Conventional Radiographic Anatomy

1. Radiographic Anatomy of the Skeleton
2. Gastrointestinal Tract
3. Urogenital Tracts
4. Vascular System
5. Chest Organs
6. Central Nervous System
7. Lymphatic System

Images without labels

Magyar nyelvű verzió
Objectives

• Review cranial and cervical imaging anatomy
• Discuss x-ray basic physics
• Discuss CT and MRI basic physics
• Review the uses for US in the H & N
• Review common pathology
Webster’s Definition

• Electromagnetic radiation of the same nature as visible radiation but with extremely short wavelength of less than 100 angstroms that is produced by bombarding a metallic target with fast electrons in a vacuum
Basic x-ray physics

- X-rays: a form of electromagnetic energy
- Travel at the speed of light
- Electromagnetic spectrum
  - Gamma Rays  X-rays
  - Visible light  infrared light
  - Microwaves  Radar
  - Radio waves
Three things can happen

• X-rays can:
  – *Pass* all the way *through* the body
  – Be deflected or *scattered*
  – Be *absorbed*
X-rays

• Like light, cause a photographic effect on film
• X-rays that penetrate through the body cause exposure of the film
• Exposed film is dark. Unexposed film is light.
X-rays Passing Through Tissue

- Depends on the energy of the x-ray and the atomic number of the tissue
- Higher energy x-ray - more likely to pass through
- Higher atomic number - more likely to absorb the x-ray
THE FIVE BASIC RADIOGRAPHIC DENSITIES

- METAL : Bright White
- MINERAL : White
- Soft tissue/Fluid : Gray
- FAT : Dark Gray
- AIR : Black
1. Frontal sinus
2. Ethmoidal sinus
3. Sphenoidal sinus
4. Maxillary sinus
5. Anterior clinoid processes
6. Hypophyseal fossa
7. Posterior clinoid processes
8. Clivus
9. Great density of the petrous part of the temporal bone
10. External acoustic meatus
11. Mastoid cells
12. Nasopharynx
13. Angle of mandible
14. Anterior arch of the atlas
15. Dens of axis
16. Posterior arch of the atlas
17. Internal occipital protuberance

A. Coronal suture
B. Lambdoid suture
C. The grooves for the branches of the middle meningeal vessels
Skull (Anteroposterior)
1. Frontal sinus
2. Crista galli
3. Cribriform plate
4. Lesser wing of sphenoid
5. Superior orbital fissure
6. Superior border of petrous part of temporal bone
7. Dense shadow of petrous part of temporal bone
8. Perpendicular plate of the ethmoid
9. Vomer
10. Maxillary sinus
11. Inferior concha
12. Ramus of mandible
13. Body of mandible
1. Anterior arch of the atlas
2. Dens of axis
3. Posterior arch of the atlas
4. Soft palate
5. Root of the tongue
6. Transverse process
7. Intervertebral disc
8. Inferior articular process
9. Superior articular process
10. Zygapophyseal (facet) joint
11. Spinous process of C7
Cervical Spine (Anteroposterior)
1. Bifid spinous process of C3
2. Superimposed articular processes
3. Uncinate processes
4. Air filled trachea
5. Transverse process of C7
6. Transverse process of T1
7. 1st rib
8. Clavicle
When to use plain x-rays in the H &N

- Initial evaluation of trauma: facial bones, nasal bones, orbits and cervical spine
- Skull fracture?
- Sinusitis
- Epiglotitis
- Opaque foreign body
- Croup
Computed Tomography

- Discovered by Sir Godfried Hounsfield
- Original research supported by the England Musical Instrument Co. (EMI) – Beatles
- Rotating x-ray source
- Rotating x-ray detector opposite side
- Scans originally took an hour or more to allow cooling of the x-ray tubes
Computed Tomography

• Can measure specific CT density of tissues
• Hounsefield Units
  0 = water density
  + 1000 = bone
  - 1000 = air
  + 60 – +80 = blood
  - 5 to –12 = fat
When to use CT in the H &N

- Head trauma
- R/O CVA or ICH
- Follow-up facial bone or orbital fracture
- Sinusitis
- Inconclusive c-spine x-rays
- Soft tissue masses (salivary, lymph nodes, not thyroid)
Magnetic Resonance Imaging

• The body contains billions of hydrogen atoms
• Hydrogen atoms may simply be composed of a proton (H+)
• This small + charge represents a tiny magnet with N and S poles
• Each proton is a tiny magnetic vector
MRI

- Proton magnetic vectors are in random alignment in the body
- Placed in a strong magnet, these tiny magnetic vectors align
- The experiment: Tip the vector off axis using an RF (radio frequency) pulse
- Images are created by the energy released as the vector returns to steady state alignment
MRI

- T1 = the “anatomic” sequence
- T2 = the “pathology” sequence
- PD (proton density) = between T1 and T2
- On T1 water is dark black
- On T2 water is bright white
When to use MRI in the H & N

• Suspected or proven brain tumors
• White matter disease
• Cerebral vascular malformations
• Posterior fossa lesions
• Early ischemic CVA (diffusion scan)
• Cervical cord
• Cervical disk disease
Advantages of CT

- Quick (10 minutes)
- Readily available
- Less expensive
- MR may require pre-approval/CT quick access
- Excellent for acute intracranial hemorrhage
- Better than MR for skull fracture
Advantages of MRI

• No bone artifact (a problem for CT especially in the posterior fossa)
• Better assessment of tumors, white matter disease and early edema
• Can detect ischemic injury 24-36 hours earlier than CT
• Detects presence of vascular flow
• Multi-planar capability
Disadvantages of MR

• No metal on patient
• No pacemakers
• No ferric aneurysm clips
• Claustrophobia
MR - Pulse Sequences

T1W

T2W
Cerebral Lobes

- Frontal
- Parietal
- Occipital
- Temporal
- Cingulate
- Insula
Cerebral Lobes

- Frontal
- Parietal
- Occipital
- Temporal
Basal Ganglia

T1

T2
Space Alien?
Sinus Imaging Anatomy

- Frontal
- Maxillary
- Ethmoid
- Sphenoid
Objective 2: The Best Test to Request

- Case 1
  - 31 y/o w/m presents with malar tenderness, nasal drainage and headache
Presumptive diagnosis:

- Acute maxillary sinusitis
Best initial test to order:

- Sinus x-rays
- Best follow-up test if more information needed:
  - Sinus CT
The Best Test to Request

- Case 2: 20 y/o male hit in the orbit with baseball, c/o pain, swelling and diplopia
- Best initial test:
  - Facial bone and orbital x-rays
- Best follow-up test:
  - CT
The Best Test to Request

• Case 3: 45 y/o female complains of a non-tender mass, thyroid gland
  – She has no other symptoms
Thyroid Masses

- Best imaged by nuclear scan and ultrasound
- MRI is a more expensive alternative
- US uses no radiation and has good spatial resolution
- US excellent to distinguish cyst from solid and for guided FNA biopsy
Advantages of Ultrasound

- No ionizing radiation
- Ability to see anatomy/pathology in real time
- Portability
- Independent from organ function
- Ability to monitor blood flow
Physics of Ultrasound

• Sound: the propagation of a pressure wave through some elastic medium
• Is there sound in space?
• Mechanical energy is being converted to a wave form that radiates energy away from the disturbance
• Humans hear up to 18 K Hz (100 K Hz for whales and bats)
Physics of Ultrasound

Periodic motion causes pressure waves
Physics of Ultrasound

**Ultrasound propagation properties**

- Velocity of sound in “soft tissue” is nearly constant = 1500 m/sec.
- Velocity of sound in bone and air differ greatly from soft tissue.
- Velocity = Frequency x Wavelength
- “Ultra” sound implies f > 1 MHz
- Wavelength = Velocity/Frequency
- Wavelength < 1.5 mm
Physics of Ultrasound

• Electrical energy is converted to ultrasound energy
• A crystalline lens located in the ultrasound transducer resonates at a specified frequency
• Ultrasound penetrates tissues: it can be transmitted, reflected, absorbed or scattered
Physics of Ultrasound

• Reflection of ultrasound is dependent upon differences in the acoustic impedance of tissue
• Bone or calcium reflects the ultrasound: echogenic / posterior acoustical shadowing
• Water of fluid transmits the sound: sonolucent
• The transducer crystal acts as a receiver
Physics of Ultrasound

- Bone or calcium: white (echogenic)
- Water: black (sonolucent)
- Soft tissues: varying shades of gray
- Fat: white (echogenic)
- Air: very poor conductor of US waves: a limiting factor
Limiting Factors

- Air or gas render diagnostic ultrasound useless
- Excessive soft tissue limits ultrasound diagnostic effectiveness
- Ultrasound loves thin patients!
The Forte’ of Ultrasound

- Distinguishing between solid and cystic lesions
- Finding fluid collections
- Defining anatomy of organs
Follicular Adenoma

• Adenomas are benign tumors
• Types: papillary, follicular and Hurthle cell
• Some function normally, rarely adenomas are hyper-functioning
• Many undergo cystic degeneration
Differential Diagnosis

- Malignant nodules
- Parathyroid adenoma
- Abcess
- Cyst
The Best Test to Request

• Case 5: 62 y/o male with hearing loss and tinnitus of 6 months duration
Presumptive Diagnosis?

- Acoustic neuroma (schwanoma)
- 8th cranial nerve, vestibular and cochlear divisions
Temporal Bone

- MRI is the procedure of choice for acoustic neuroma
- MRI is better than CT in the posterior fossa
- CT is best when the suspected pathology is in the middle ear (cholesteatoma)
CC - Carotid Canal
EC - Eustachian Canal
CA - Cochlear Aqueduct
C - Cochlea
PA - Petrous Apex
CP - Cochlear Promontory
FNC - Facial Nerve Canal

EAC - External Auditory Canal
LPM - Long Process Malleus
LPI - Long Process Incus
SCTT - Semicircular Canal Tensor Tympani Muscle
FN - Facial Nerve
M - Malleus
TT - Tegmen Tympani
EAC - External Auditory Canal
LPM - Long Process Malleus
C - Cochlea
OW - Oval Window

HFN - Horizontal Facial Nerve
SPI - Short Process Incus
AAA - Aditus Ad Antrum
ISJ - Incudostapedial Joint
S - Stapes
BC - Basal Turn Cochlea

LEGEND CONTINUED ON NEXT FRAME ➤
Best Test to Request

- Case 6: 60 y/o male with non-tender mass over the right mandible. He noticed the mass 2 years ago. The mass has slowly grown larger. No other symptoms.
Diagnosis

• Mixed Adenoma of the parotid gland
• It’s difficult to distinguish benign from malignant salivary gland tumors
Review
Head and Neck Imaging

- Nuclear thyroid scan best for thyroid function and size
- Ultrasound best for cross-sectional thyroid imaging or distinguishing solid from cystic lesions
- Plain x-rays are preferred for screening of facial/orbital trauma and sinusitis
Head and Neck Imaging

- CT best for sinuses, orbital trauma, facial bone trauma and the temporal bone
- MRI best for the cranial nerves, posterior fossa lesions (brain) and for the salivary glands
Best Test to Request

• 15 y/o male hit in the nose by a car door
• 20 y/o female with palpable thyroid nodule
• 6 y/o girl with suspected thyroglossal duct cyst
• 63 y/o male with suspected facial n. neuroma
• 27 y/o female with suspected temporal bone fracture
Cranial Imaging

- The student should be able to recognize subdural and epidural hematoma
Epidural Hematoma
Subdural = “epi-arachnoid”
CNS Trauma

Objectives

• Review effects of cranial trauma
• Become familiar with intracranial hemorrhage including:
  – Epidural hematoma
  – Subdural hematoma
  – Parenchymal contusion
  – Shear injuries
  – Contra coup injuries
Epidural Hematoma

- A traumatic extracerebral blood accumulation
- Occurs in the potential space between the skull and tightly adhered dura
- 90% arterial 10% venous
- 85-95% association with skull fracture
- Bleeding comes from meningeal arteries
- 66% middle meningeal artery
Epidural Hematoma

• Arterial bleed under pressure strips dura from the inner table of the skull
• Epidural hematoma = biconvex shape
  – Firm adherence of the dura at the hematoma margins
  – Strong dura attachment at cranial sutures
  – High pressure arterial bleeding
Epidural Hematoma

- Acute bleeding 50 to 80 H.U., hyperdense to brain parenchyma
- Active bleeding may be of slightly lower density
- Important to recognize active bleeding
Epidural Hematoma
Clinical Presentation

- Variable and non-specific
- 1/3 of the time “classic” lucid interval
- If confined to epidural space, may remain conscious
- If associated intracerebral or intra-dural bleeding, most lose consciousness
- 9% of EDH increase in size after the initial CT
Epidural Hematoma

- If small, non-operative treatment
- If temporal, may produce pressure on the brain stem – more likely operative
- In children, skull fracture may not be seen (elasticity of bone)
<table>
<thead>
<tr>
<th>Stage of Hematoma</th>
<th>Age of Hematoma</th>
<th>Hemoglobin Type</th>
<th>T1-weighted Scan</th>
<th>T2-weighted Scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperacute</td>
<td>0 - 24 hours</td>
<td>oxyhemoglobin</td>
<td>isointense</td>
<td>isointense</td>
</tr>
<tr>
<td>Acute</td>
<td>1 - 3 days</td>
<td>deoxyhemoglobin</td>
<td>isointense</td>
<td>hypointense</td>
</tr>
<tr>
<td>Subacute</td>
<td>3 - 14 days</td>
<td>Intracellular methemoglobin Extracellular methemoglobin</td>
<td>hyperintense</td>
<td>hyperintense</td>
</tr>
<tr>
<td>Chronic</td>
<td>≥ 2 weeks</td>
<td>Extracellular methemoglobin Hemosiderin (around periphery)</td>
<td>hyperintense</td>
<td>hyperintense</td>
</tr>
<tr>
<td>Ancient</td>
<td>months-years</td>
<td>Nonparamagnetic heme pigments Hemosiderin (around periphery)</td>
<td>hypointense</td>
<td>hyperintense</td>
</tr>
</tbody>
</table>
Subdural Hematoma

- Subdural: a potential space between the dura and the meninges covering the brain (arachnoid and pia)
- Cerebral cortical veins are invested into the meninges closely associated with the surface of the brain
Subdural Hematoma

- Venous bleeding
- Tearing of bridging cortical veins
- Occurs during acceleration – deceleration injuries
- Results because of difference in inertia of the skull vs. the brain & cortical veins
- SDH more common with falls
- EDH more common with MVA
Subdural Hematoma

- 24% of MVA have subdural hematoma
- SDH more common in older patients
- SDH’s are crescent-shaped
- Spread over a larger area, limited by the falx and the tentorium
Subdural Hematoma

- Poorer prognosis with associated intraparenchymal injury
- Simple SDH: no associated injuries
- Mortality rate exceeds 50% in some studies
  - Acute 0 to 3-4 days hyperdense
  - Subacute 3 to 20 days isodense
  - Chronic > 20 days hypodense
Subdural or Epidural?
T1 coronal post gad
Subdural or Epidural?
Shear Injuries

• Occur with rapid acceleration/deceleration
• Usually involves large WM tracts: corpus callosum, brainstem and deep white matter
• Occurs at gray-white matter interface due to slight differences in mass
• Minor differences in tissue inertia
Motor Vehicle Accident

- High speed
- 28 y/o female
- Only symptom: difficulty swallowing
Increased T2 intensity = edema
T1 with gad: solitary nucleus CN IX and X pass
Subdural or Epidural?
Subdural or Epidural?
CNS
Stroke, Tumors and Degenerative Disease
LMCA infarction with midline shift

• Most useful landmark for measuring midline shift: SEPTUM PELLUCIDUM
Findings

- Symmetrical bifrontal atrophy
- Frontal lobotomy
- Egar Moniz won Nobel Prize for Medicine in 1949
- Procedure performed until late 1960’s
- Done for refractory psychiatric disorders
- Sequellae included seizures and minor motor disturbances
63 y/o male with acute visual disturbance
1 week later
9 months later
Subdural or Epidural?
Objectives

- Show and tell
- Imaging cerebral vascular injuries (stroke)
- Brain tumors
- Cortical atrophy
- Degenerative white matter disease
- Discuss when to use CT and MR
Hypointense T1, Hyperintense PD and T2 Pontine Infarction
Findings in ischemic infarction

- **MRI**
  - Early detection possible
  - Hypointense T1, hyperintense T2 = edema
  - White and gray matter affected
- **CT**
  - Normal in 1st 24-36 h
  - Hypodensity = edema
  - CSF density = porencephaly (chronic)
History

- 74 y/o male with hypertension
- Acute decreased mental status
- Right hemiplegia
- Aphasia
30 y/o female “feels funny”
CNS vasculitis

- Causes: idiopathic, infectious, autoimmune and drug induced (cocaine)
- Produces arteriole spasm and infarction
- Underlying cause in this case was SLE
55 y/o female with headache
Arachnoid Cyst

- Fluid similar to CSF
- 1% of intracranial masses
- Congenital meningeal malformation
- Male:female 3:1
- 75% have symptoms: seizures and/or headaches
Arachnoid Cyst of the Velum Interpositum

- CSF intensity
54 y/o female with positional headaches

- Colloid cyst
- Occur in the 3rd ventricle, foramen of Monro
- 20% of intraventricular masses
- Ventricular obstruction intermittent
- Contains mucinous material
History

- Hearing loss
- Ringing in ear
- Headache
Acoustic Neuroma

- Pts. Presents with tinnitus and hearing loss
- MC cerebellopontine angle (CPA) tumor
Meningioma

• MC non-glial brain tumor
• Seen primarily in women 40 – 60 y/o
• Arise from the dura
• Classic appearance
• Calcification easier to see on CT
• Tend to occur ant > posterior, midline > lateral
History

• 20 y/o with headache and visual disturbance
SATCHMO

- Suprasellar extension of pituitary adenoma
- Aneurysm
- Teratoma
- Craniopharyngioma
- Hypothalamic glioma
- Meningioma
- Optic glioma
Craniopharyngioma

- Two age peaks 8-12 and 40-60
- Occur in the suprasellar region, occasionally in the sella
- Benign
- Present with headache and/or visual disturbance
- Cystic mass with mural nodule
- Arise from squamous cells from Rathke’s cleft
Brain Stem Astrocytoma

- ¼ of all posterior fossa tumors
- Age range 3-10, male = female
- Produces ventricular obstruction due to ventricular obstruction
- Other posterior fossa tumors: ependymoma, medulloblastoma, pilocytic astrocytoma and hemangioblastoma
Juvenile Pilocytic Astrocytoma

• Low grade astrocytoma
• Associated with neurofibromatosis I (cerebral aneurysms, optic glioma, hamartomas)
• Classic cystic lesion with enhancing mural nodule
Stroke versus Tumor

• Onset
• Symptoms
• Distribution of edema
Astrocytoma

- 40 to 60 y/o
- Present with headache, seizure and/or focal neurologic deficit
- Sparing of gray matter as seen on CT helps to distinguish tumor from infarction
• Hemorrhagic stroke
• Hemorrhagic contusion
• Hemorrhagic metastasis
• AVM
• Cocaine infarction
• Hypertensive bleed
Facts about cerebral metastasis

- 95% Lung, breast, GI, renal, and melanoma
- 33% - 40% of brain tumors
- MC location gray-white matter interface
- 80% are multiple
History

• 35 y/o female
• Fleeting parasthesias
• Occasional visual disturbances (blurred vision)
• Scotoma (flashes of light)
Multiple Sclerosis

- Thought to be an autoimmune demyelinating disease
- MC DM disease except for small vessel ischemic disease of aging
- 20 – 40 y/o female: male 2:1
- Periventricular white matter, corpus callosum and pons
**Diagnosis: Pontine infarct**

Regarding infarcts of the posterior circulation, the pons is the most commonly infarcted region. The most common etiology of posterior circulation infarct is stenosis or occlusion of the basilar artery. Other large arterial stenoses may be seen. Another frequent cause of posterior circulation infarct is cardiac embolus. The median appearance of pontine infarct is due to occlusion of the perforators of the basilar artery which supply each side of the pons in a parallel fashion. Hence unilateral, geographic appearance of typical pontine infarcts. Enhancement pattern of stroke is variable but gadolinium enhancement may persist for a few months following the infarct.

Other entities listed in the differential are much less likely. Demyelinating disease may involve the pons; however, the laterality of this lesion would be extremely unusual. Likewise, neoplasm is highly unlikely given the clinical history and the lack of mass effect with no significant enhancement. Related Cases.


**Diagnosis: Dural sinus thrombosis**

Dural sinus thrombosis most commonly involves the superior sagittal sinus. The sigmoid, transverse, and cavernous sinuses may also be involved. The more common disposing factors include pregnancy, dehydration, oral contraceptives, infection, and coagulopathy. Up to one-quarter of all cases of dural sinus thrombosis are pathic. Patients often present with vague symptoms including headache and confusion. Diagnosis is often delayed which may result in progression to venous stenosis. On enhanced CT, a filling defect may be present in the superior sagittal sinus known as the ‘delta’ sign which consists of clot within the opacified sinus. Infection with hemorrhage may also be identified. High signal on T1 and T2 weighted images in the involved sinuses is characteristic. However, slow flow in the al sinuses may mimic dural sinus occlusion. The most reliable way to exclude dural sinus occlusion on MR is to obtain a slow-flow sensitive MRA sequence such 3D phase contrast. Related Cases.

- Start of case
- History
- [ T1 sag pre || PDW ax || T2 axials || MRA ]
- DDx
- [ Table of Contents || Next Unknown ]
Enhanced CT

- Findings
- History
- [ T1 sag pre || PDW ax || T2 axials || MRA ]
- DDx
- Dx
- [ Table of Contents || Next Unknown ]
Plate 14: Acute subdural haematoma.

1 a, b, c
Acute subdural haematoma on the right overlying the entire hemisphere. Severe compression and displacement of the ventricular system. Blood in the interhemispheric fissure. Dilatation of the left posterior horn (blockage of the foramen of Monro).

2
Acute subdural haematoma on the left as a contrecoup lesion.

3
Acute subdural haematoma secondary to a gunshot wound. Coagulated and uncoagulated blood in the region of the haematoma. Displacement of the...
**Diagnosis:** Presumed colloid cyst.

Colloid cysts are invariably located in the third ventricle at the foramen of Monro. They contain thick, viscous, proteinaceous or mucinous fluid and may grow to as large as 4 cm in diameter. Colloid cysts present in adults and make up 1/5 of all intraventricular masses. Patients often have intermittent headache secondary to traction of the flow of CSF through the foramina of Monro. On CT, most colloid cysts are hyperdense masses and may resemble acute hemorrhage. Calcification is not usually seen. Enhancement is unusual but if present is in the periphery of the cyst. They may demonstrate almost any combination of signal characteristics on MR. Usually, the central portion has increased signal on T1 with decreased signal on T2 due to the high protein content. A rim of variable thickness and signal is typical.

There is no differential in this case. The general differential of anterior third ventricular masses includes meningioma, ependymoma, choroid plexus papilloma, ocytoma, and metastasis among others. Artifact associated with a CSF pulsation through the foramina of Monro into third ventricle can simulate a small colloid cyst on T2 weighted scans. This patient was shunted years earlier to relieve his headache and has been followed with MR ever since. Due to the typical appearance of the mass, no biopsy was performed. Related Cases.

- Start of case
- History
**Diagnosis: Acoustic schwannoma**

Acoustic schwannomas typically present in adults with high frequency hearing loss and tinnitus. Vestibular symptoms are a late manifestation. They enhance strongly and have an ice cream cone appearance due to the combination of intracanalicular and cisternal components. Larger schwannomas may undergo cystic change as in this case. Hemorrhage and calcification are uncommon. Arachnoid cysts are associated in 7% of acoustic schwannomas. Bilateral acoustics are seen in 25% of Poincon’s syndrome. The intracanalicular extension and lack of a dural tail strongly favor schwannoma. A meningioma would be more broad based without the meninx intracanalicular extension or necrosis. Other CPA angle masses include ependymoma, dermoid, metastases and aneurysms of the anterior inferior cerebellar artery. Related Cases:

- [Start of case](http://fibonacci.rad.washington.edu/neuroRR/613/dx.htm) | [History](http://fibonacci.rad.washington.edu/neuroRR/613/dx.htm) | [T2 ax || T1 ax post || T1 cor post](http://fibonacci.rad.washington.edu/neuroRR/613/dx.htm) | [DDx](http://fibonacci.rad.washington.edu/neuroRR/613/dx.htm) | [Table of Contents || Next Unknown](http://fibonacci.rad.washington.edu/neuroRR/613/dx.htm)
**Diagnosis:** Brain stem astrocytoma

In stem astrocytomas represent approximately 1/4 of all infratentorial neoplasms. Peak incidence is between 3 and 10 years of age with boys and girls being affected equally often presenting with cranial nerve findings. Hydrocephalus is uncommon since most become clinically apparent prior to obstruction of the fourth ventricle. Calcification and hemorrhage are unusual and enhancement is variable. Encephalitis could have this appearance, but that would be much less likely. Endymoma is not in the differential since it would typically be within the fourth ventricle and enhance heterogeneously. Other infratentorial pediatric neoplasms include juvenile pilocytic astrocytoma, hemangioblastoma and medulloblastoma. JPAs and hemangioblastomas often present as cystic masses in the cerebellar hemisphere with an enhancing mural nodule, however, they may be solid. JPAs also occur around the 3rd or 4th ventricle. Medulloblastoma is an intensely enhancing mass usually in the midline but may present in the cerebellar hemisphere. Related Cases.

- Start of case
- History
- [ T1 sag pre || T2 ax || T1 ax post || T1 cor post ]
- DDx
**Diagnosis: Grade 3 astrocytoma**

Grade lesions (3, 4) represent 1/3 of all astrocytomas. Patients often present between the ages of 40 and 60 with seizures, headache or focal neurologic deficit. Grade astrocytomas typically show some enhancement as well as mass effect and vasogenic edema in the surrounding white matter. They may have small foci of hemorrhage; however, large hemorrhages are unusual. Calcification is very uncommon.

The differential for this case is limited given the clinical history and the finding of a non-enhancing mass infiltrating the white matter. A metastasis should enhance, so a single metastasis of this size is unusual without other lesions. Infarct is unlikely secondary to the involvement of both the ACA and MCA territories. However, subacute infarct may have mass effect and enhance. Related Cases.

- **Start of case**
- **History**
- [T2 ax] [T1 sag post] [T1 ax post]
- **DDx**
Diagnosis: Meningiomas

Meningiomas are usually dural based, intensely enhancing extraaxial masses presenting in woman between the ages of 40 and 60 containing progesterone and oestrogen receptors. They are the most common primary CNS tumor of non-glial origin. Typical locations are parasagittal, over the convexities and the sphenoid ridge. They may be seen in association with neurofibromatosis type II and are multiple in up to 9% of patients, many of whom have NF II. Meningiomas are aseptical in 2% of cases. They are hyperdense on CT and 1/4 may have some calcification. Hemorrhage is unusual but cystic change may be seen. Meningiomas are typically isointense to gray matter on T1 while T2 signal is more variable. A dural tail may be present due to their extraaxial location as well as erosion of the overlying calvarium. A metastasis may rarely be dural based and simulate a meningioma. However, in this case, dural based metastases of this without invasion or necrosis would be very unusual.

Related Cases

- Start of case
- History
- [ CT post sup || T1 cor pre || T2 ax || T1 ax post || T1 cor post ]
- DDx
- [ Table of Contents || Next Unknown ]
**Diagnosis: Pilocytic astrocytoma with neurofibromatosis type I**

Neurofibromatosis type I is an autosomal dominant phakomatosis seen on chromosome 17 which is associated with cafe au lait spots, low grade astrocytomas, optic nerve gliomas, cerebral aneurysms, plexiform neurofibromas, white matter and basal ganglia hamartomatous lesions, hypoplastic sphenoid wing among many others. Optic nerve glioma is the most common CNS tumor in NFI and occurs in up to 15% of cases. Twenty five percent of all patients with optic nerve glioma have NF1. Pilocytic astrocytoma is one of the low grade astrocytomas seen in neurofibromatosis type I. They typically appear in children or young adults and are usually located in the third or fourth ventricles in the region of the hypothalamus or the optic chiasm. Another common location is in the cerebellar hemisphere. They are usually ologically benign lesions; however, up to 1/3 may be clinically aggressive. Leptomeningeal dissemination has been reported. On CT and MR, the classic appearance is of a cystic mass which is hypointense on T1 and bright on T2 with an enhancing mural nodule. Calcification occurs in 10% of pilocytic astrocytomas. Procephalus is a complication of pilocytic astrocytoma and is dependent upon the size and location of the mass.

Neurofibromatosis type II on the other hand is typically associated with bilateral acoustic schwannomas and is much less common. It is transmitted as an autosomal dominant trait on chromosome 22. Percutaneous manifestations of NF2 are unusual. Other lesions seen in NF2 include meningiomas, chordomas, and cranial calcification. Without the other stigmata of neurofibromatosis type I as seen in this patient, the differential diagnosis of a cystic lesion in the midbrain with enhancing mural nodule should include, in addition to pilocytic astrocytoma; metastasis, particularly in an older age group, ganglioglioma and hemangioblastoma.
**Diagnosis:** Hemorrhagic melanoma metastasis

CT scans show multiple lesions in the brain. The lesions are hypodense and irregular in shape. The patient is a 65-year-old male with a history of melanoma in the right lower extremity. The lesions are most consistent with melanoma metastasis. The patient has severe headache, nausea, and vomiting.

**History:**

The patient has a history of melanoma in the right lower extremity treated with surgery and chemotherapy. The patient was on antihypertensive medication for a history of hypertension. The patient has no history of head trauma.

**Dx:**

Melanoma metastasis to the brain.

**DDx:**

Malignant glioma, metastatic breast cancer, and meningioma.

**Related Cases:**

See Table of Contents for similar cases.
**Diagnosis:** Metastatic lung carcinoma

% of all intracranial tumors are metastases and are the most common tumor of the posterior fossa. Lung, breast, GI, renal, and melanoma make up 95% of all metastases. 80% of CNS metastases are multiple lesions, usually in the subcortex. Most intracerebral metastases are parenchymal; however, leptomeningeal and dural metastases may also be seen. Metastases are typically round, ring enhancing subcortical lesions with surrounding vasogenic edema which may be identified by decreased signal on T1 and increased signal on T2. Metastases typically have increased T2 signal centrally, however some metastases may have decreased T2 signal. These include mucin secreting tumors like colon carcinoma and other neoplasms with very high ratio of nuclear to cytoplasmic material such as lymphoma.

General differential of multiple ring enhancing lesions includes multiple astrocytomas, mets, toxoplasmosis, cysticercosis, tuberculosis and bacterial abscesses. S lymphoma typically presents as a bulky deep white matter or deep gray homogeneously enhancing mass. If the patient is immunocompromised, the findings in S lymphoma may be more atypical including central necrosis and ring enhancement. Hydatid disease of brain which is caused by the canine tapeworm innococcus granulosus is not a differential since it usually presents as a single, well defined cyst with no surrounding edema and little or no ring enhancement. This entity had known metastatic lung carcinoma. This clinical history plus the findings of multiple subcortical ring enhancing lesions with vasogenic edema makes astatic disease the best choice. Related Cases
**Diagnosis:** High grade vermian astrocytoma

tastasis is the most common intraaxial posterior fossa tumor in adults. 80% of parenchymal CNS metastases are multiple. Astrocytoma in this age group and idion is less common. Medulloblastoma is not in the differential since it is a tumor of much younger patients. Also, they tend to have a more homogeneous ncrement pattern. Ependymoma and choroid plexus papilloma are intraventricular lesions and may enhance like this but are not considerations since this tumor is axial and effaces the fourth ventricle due to external mass effect rather than from being within the ventricle. Related Cases

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