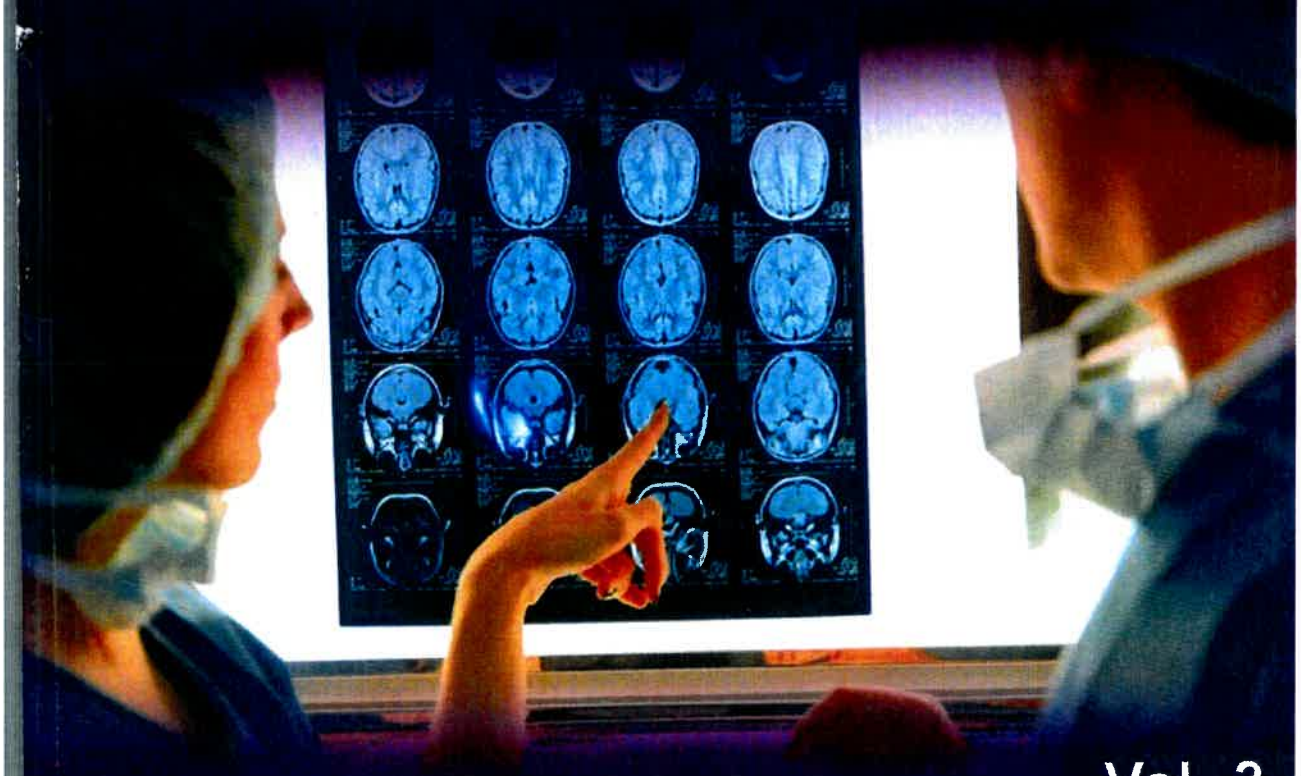
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Section 6

Neuroradiology

CHAPTER 6.1

Imaging in Head Trauma

CLASSIFICATION:

- Traumatic brain injury –basis of GCS
  - 13-15: Mild
  - 9-12: Moderate
  - 3-8: Severe

PRIMARY	SECONDARY – result of primary brain injuries
Scalp and skull injuries	Herniation syndromes
Extra axial hematomas – EDH, SDH, SAH	Cerebral edema
Parenchymal injuries – contusions, DAI	Cerebral ischemia
Vascular injuries – DVI, fractures	Vascular injuries

IMAGING MODALITIES: NCCT

- Primary study
- Indications:
  1. Patients with a GCS score <13
  2. All traumatized children under 2 years of age
- **New Orleans Criteria In Minor Head Injury-**

CT indicated if GCS= 15 plus any of the following -
• Headache • Vomiting • Patient >60yrs old • Intoxication (drugs, alcohol) • Short term memory deficits (anterograde amnesia) • Visible trauma above clavicles • Seizure

- **Canadian Head CT Rule In Minor Head Injury –**

CT if GCS=13-15 and witnessed LOC, amnesia or confusion
High risk for neurosurgical intervention – • GCS <15 at 2 hrs • Suspected open / depressed skull fracture • Clinical signs of skull base fracture • >/= 2 vomiting episodes • Age >/= 65yrs Medium risk for brain injury detected by head CT- • Antegrade amnesia >/= 30mins • "Dangerous mechanism" (i.e., auto-pedestrian, ejection from vehicle, etc.)

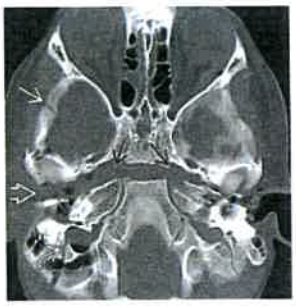
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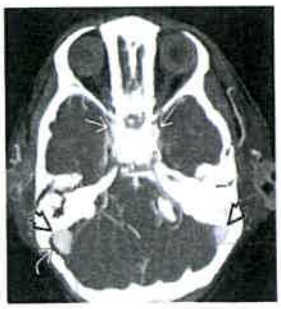
- Repeat CT: required for clinical or neurologic deterioration, GCS not improving.



IMAGING MODALITIES: CTA

- Indications –
  1. Penetrating neck injury
  2. Fractured foramen transversarium or facet subluxation on cervical spine CT
  3. Skull base fracture traverses the carotid canal /dural venous sinus
  4. Le fort fracture 2 or 3
  5. DAI with GCS <6
  6. Near hanging injuries





Diastatic fracture at Spheno-occipital synchondrosis coursing through carotid canal and foramen lacerum

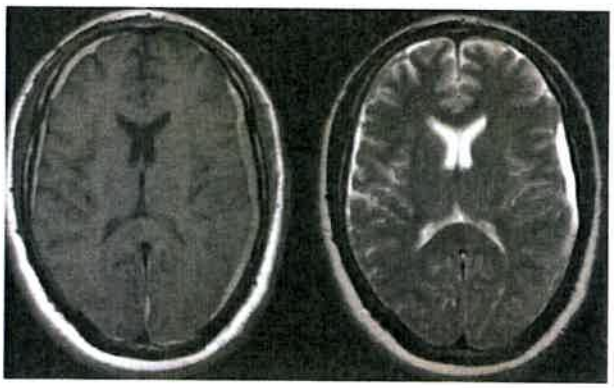
IMAGING MODALITIES: MRI

Indications –

1. Suspected DAI- only condition in primary head injury in which MRI is done to pickup small microbleeds.
2. Suspected non accidental injury or child abuse – to pickup multifocal and different ages of bleeds.
3. Injuries older than 24-48hrs

	T1	T2
Hyperacute (<24hrs)	I	B
Acute (1-2day)	I	D
Early subacute (3-7days)	B	D
Late subacute (7-14days)	B	B
Chronic (>14days)	D	D

I=intermediate signal intensity, B=bright signal intensity, D=dark signal intensity

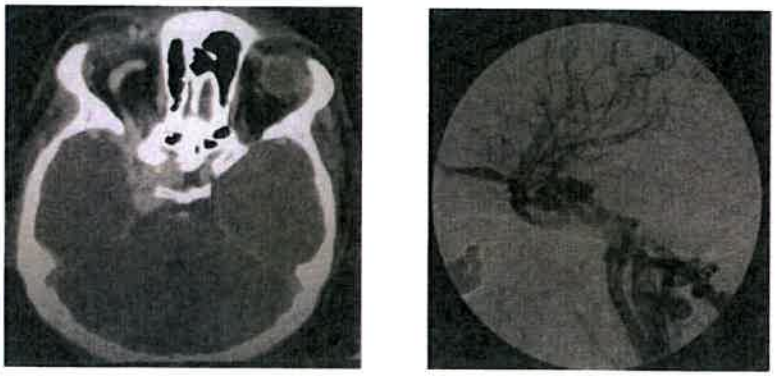


Early subacute SDH (R) Hyperacute SDH (L)

IMAGING MODALITIES: DSA

Indications –

1. Pseudoaneurysms
2. CCF
3. Other vascular injuries



Fistulous communication between carotid artery and cavernous sinus

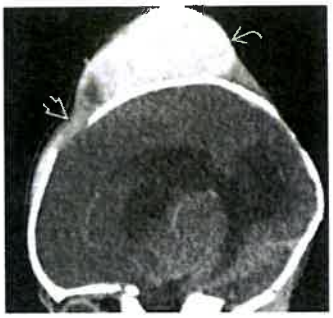
CT CHECKLIST:

- Scout – C-spine, Jaw/Facial injuries, FB
- CT brain windows-
  1. Scalp
  2. Skull fractures – bone recons > bone windows
  3. Extra axial hematoma –EDH, SDH, SAH
  4. Pneumocephalus
  5. Contusions
  6. DAI
  7. IVH
  8. Subdural window :150-200 HU



SCALP INJURIES:





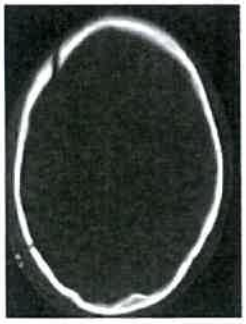
Cephalohematomas



Subgaleal hematoma

CEPHALOHEMATOMAS	SUBGALEAL HEMATOMA
Between the outer surface of the calvarium and the pericranium: extracranial EDH	Subaponeurotic collections
Do not cross suture lines	Spread diffusely
May undergo dystrophic calcification, creating a firm palpable mass.	Can cause significant blood loss

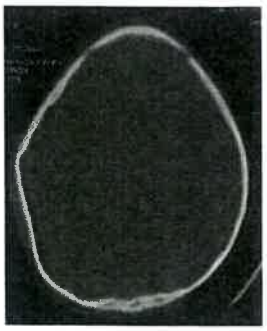
SKULL FRACTURES:



- Linear fractures vs sutures.
- Sutures are
  1. serrated
  2. Have cortical rims
  3. b/l symmetrical



- Depressed fracture mc associated with-
  1. contusions
  2. CSF leaks leading to subdural collections
  3. dural venous sinuses injury, jugular bulb injury



- Ponds fracture /ping pong fracture



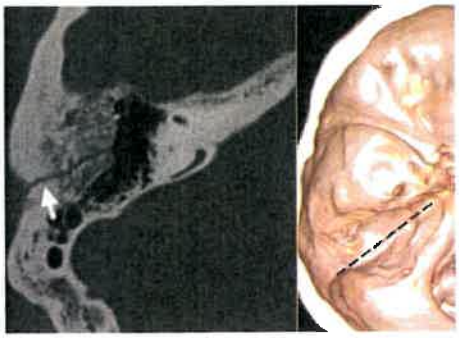
Sutural diastasis of spheno-occipital synchondrosis



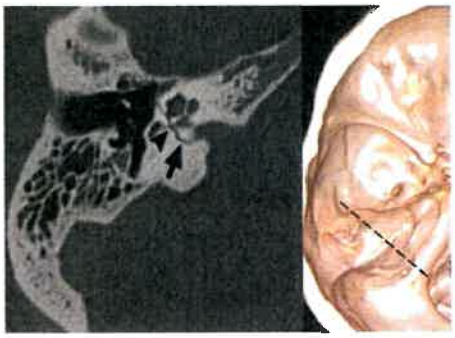
- Comminuted fracture >/=3 fragments



- Growing skull fracture / Leptomeningeal cyst – delayed (after 2 months) complication of skull fracture, seen in <3yrs of age.



Longitudinal temporal bone fracture



Transverse temporal bone fracture

Ulrich Classification

LONGITUDINAL	TRANSVERSE
Parallel to long axis of petrous temporal bone	Perpendicular to long axis of petrous temporal bone
Conductive hearing loss	Sensorineural hearing loss
Ossicular injury, TM rupture	Facial nerve paralysis
Otic capsule involvement rare	Injury to labyrinth and cochlear nerve more common

EDH:

- 90% arterial cause - MMA (anterior part of pterion part)
- 10% venous cause –dural venous sinus injuries
- 90-95% are adjacent to skull fractures
- Mc- squamous part of temporal bone
- 10% can cross suture lines, when sutural diastasis +.
- Midline cross- yes.
- Indications of decompression -
  1. Diameter – >1.5cm
  2. Volume - >30 cc
  3. Midline shift - >5mm
  4. Swirl sign – sign of active bleed, areas of hypodensity within hyerdense hematoma



Venous EDH:

- Fracture crosses dural venous sinus
- Low pressure
- Can cross sutures, dural attachments
- Sites -
  1. Vertex: SSS
  2. Ant temporal: Sphenoparietal sinus
  3. Post fossa: Transverse sinus
  4. Clival



Vertex



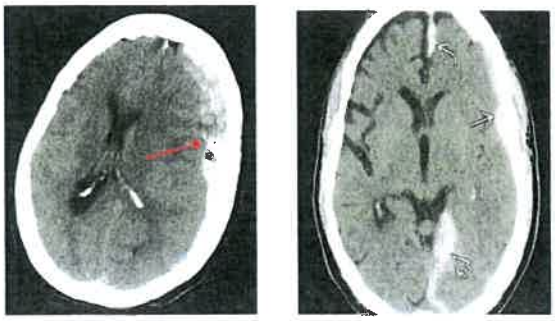
Anterior temporal venous EDH



Clival EDH

SDH:

- Torn cortical bridging veins
- MC location is along cerebral convexities
- Crescent shaped hematoma crossing the suture line
- Falcine SDH are mc. Tentorial SDH are missed frequently on axial view, better seen on coronal view.
- Indications of decompression:
  1. Diameter - >2cm
  2. Midline shift - >3mm of thickness of SDH



Falcine SDH & Tentorial SDH

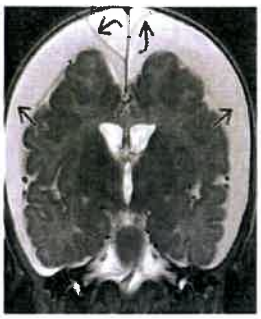


B/L SDH



Parfait effect –hematoma sets and forms jelly kind consistency



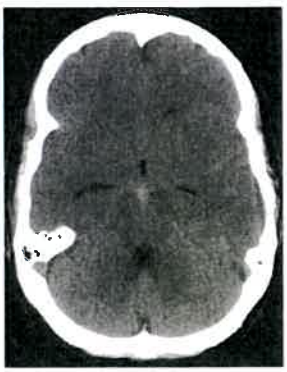


Different ages of SDH: hematocrit effect

SAH:

- MCC- traumatic SAH
- tSAH - Focal /Patchy
- ntSAH- central, cisternal → CTA





NA Perimesencephalic SAH (NAPMSAH) –venous



Sulcal space SAH

- Most sensitive - FLAIR
- Pseudo-SAH: d/d -
  1. Meningitis
  2. Ruptured dermoid
  3. Hyperbaric oxygen
  4. Polycythemia
  5. Intrathecal contrast /Gd- BBB rupture
  6. Moya moya syndrome
  7. CSF flow artefact

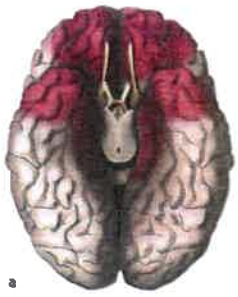


Pseudo-SAH

CONTUSIONS:

- Can be hemorrhagic or non-hemorrhagic
- MC intra axial injury
- Superficial
- MC location – frontal lobe, anterior temporal lobe because of many bony projections in these location.
- Enlarge in 12-24hrs





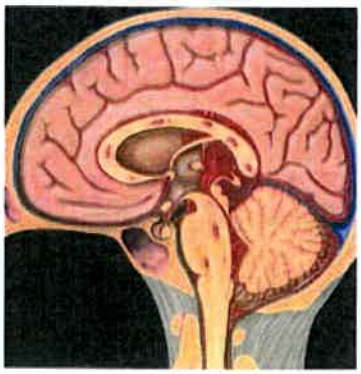
COUP-CONTRE COUP INJURIES:

- Direct impact on an area and shearing effect is seen on area diagonally opposite to it .



DAI:

- Traumatic axonal 'shear' injury
- Unequal rotation or deceleration of grey matter and white matter of different density due to high energy trauma cause shearing of axons leading to microbleeds.
- Usually spares cortex, involves subcortical / deep WM
- CT: Normal or petechial injuries
- MRI: DWI, FLAIR << GRE most sensitive, SWI, DTI
- Adams staging
  1. Stage I - frontal, temporal lobes, int. capsule, cerebellum
  2. Stage II - stage I + corpus callosum
  3. Stage III - stage II + brainstem involvement

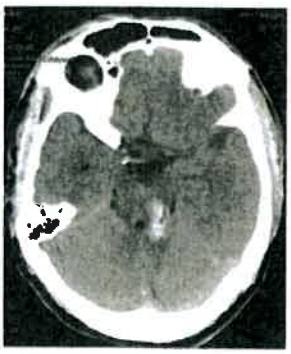




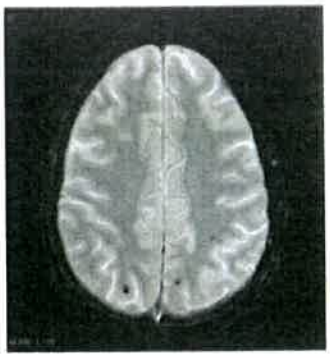
Stage 1: Microbleeds @GWJ



Stage 2: DAI @corpus callosum



Stage 3: involving Brainstem



T2W GRE



SWI: blooming d/d → Granuloma CAA Septic emboli, Vasculitis, Air emboli

DVI: Extreme DAI cannot be distinguished radiologically.

IVH:

- Rotation induced tearing of subependymal veins
- May cause obstructive hydrocephalus when these clots block csf flow.

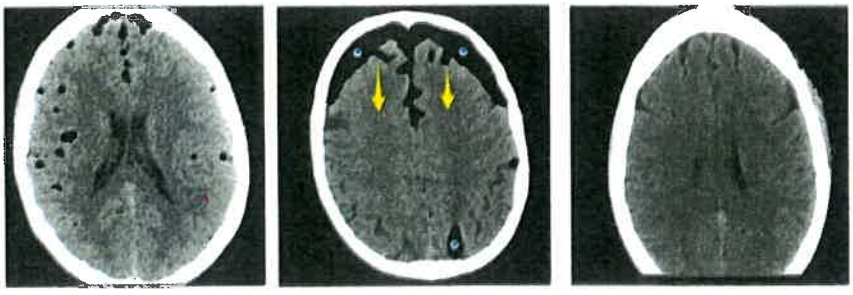


PNEMOCEPHALUS:

- Usually low pressure
- Mount Fuji sign- tension pneumocephalus
- D/d- fat



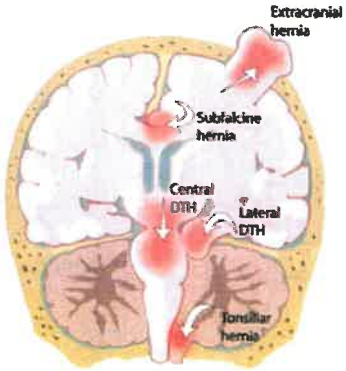
Scout view



Tension pneumocephalus

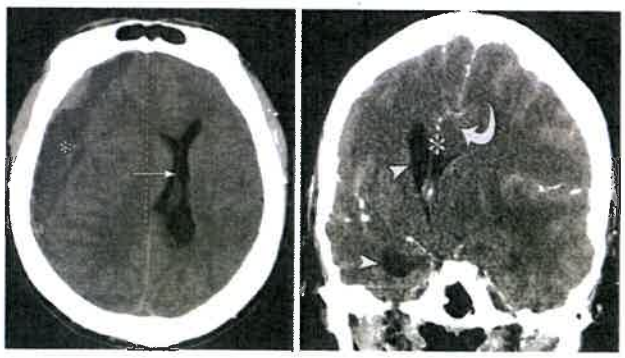
CEREBRAL HERNIATIONS:

- Secondary impact of trauma

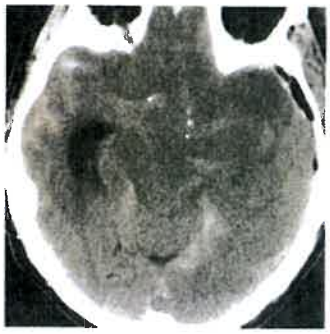


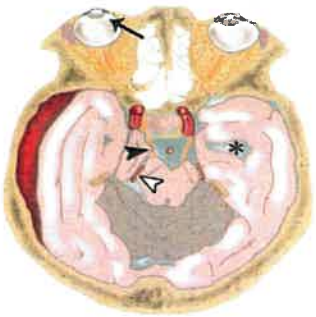
Types of herniation –

1. Subfalcine herniation – mc, cingulate gyrus herniates here. Associated complications –
   a. Foramen of Monroe can get obstructed
   b. 2° vascular injury to ACA
   c. ICV injury
2. Transtentorial herniation –
   a. Ascending transtentorial herniation – rare
   b. Descending transtentorial herniation - 2nd mc
      - Lateral DTH>> central DTH
      - Lateral DTH – has uncal or parahippocampal gyrus herniating
3. Tonsillar herniation



Subfalcine herniation

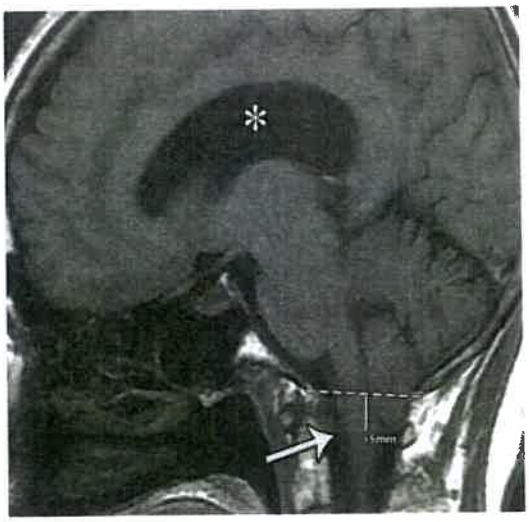


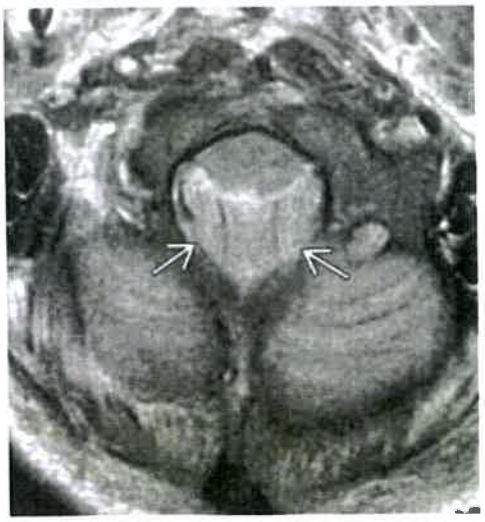


Transtentorial herniation

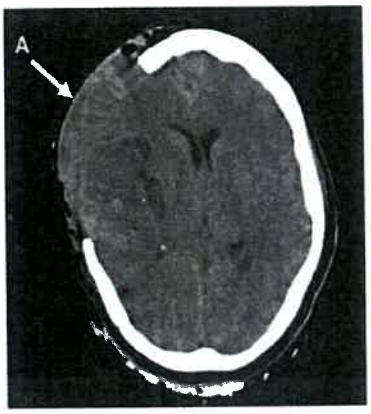
Uncal herniation:

1. I/L 3rd CN palsy – down and out + dilated pupil
2. PCA infarct
3. I/L hemiplegia – false localizing sign/ Kernohan notch

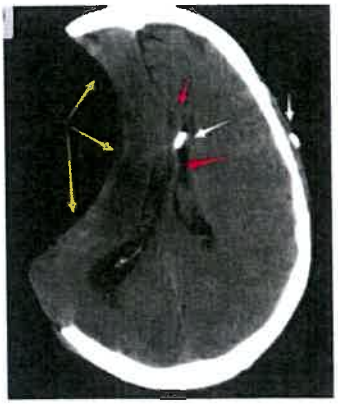




Tonsillar herniation – if tonsil is below 5mm McRae's line



Extracranial herniation- occurs in case of decompressive craniectomy



Paradoxical herniation / sinking flap syndrome- when atmospheric pressure >ICP

CHAPTER

6.2

Imaging in Brain Tumors Part-1

INTRODUCTION

PRIMARY CNS NEOPLASMS BY LOCATION	PRIMARY CNS NEOPLASMS BY HISTOLOGIC GROUP
• Meninges ,36% • Cerebral hemispheres ,31% • Sellar regions, 17% • Cranial nerves, 7% • Brainstem, cerebellum ,4% • Spinal cord / cauda equina, 3% • Ventricles ,1 % • Miscellaneous ,1%	• Meningioma, 36% • Astrocytoma, 21% • Pituitary, 16% • Nerve sheath, 8% • Oligodendroglioma, 3% • Ependymal, 2% • Embryonal, 2 • All others, 11%

APPROACH TO BRAIN TUMOURS

- Age
- Intra-axial vs Extra-axial
- Compartment-Supratentorial, Infratentorial, Intraventricular, CP angle, Sella/Pineal
- Midline crossing
- Subarachnoid seeding
- Cortical-based
- T1, T2, DWI
- Contrast enhancement
- Characteristics: Calcification, fat, hemorrhage, cystic, necrosis
- Perfusion/ MRS
- Edema-VASOGENIC vs CYTOTOXIC
- MASS EFFECT
- Bone changes
- HIGH GRADE VS LOW GRADE
- Multiple?

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