Imaging of brain tumors

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Issues in radiologic-pathologic correlation

- Complex relationship between enhancement and tumour grade
- Most malignant tumours enhance
- Yet, some of the most benign tumours also enhance
- Constellation of imaging and demographic findings seen in low grade enhancing tumours
ROLE OF RADIOLOGIST

- Most likely diagnosis = histopath
- Look for extent and spread
- Part of multidisciplinary team
GOALS OF IMAGING

Pre Therapy
- Extent of the tumour
- Differential diagnosis
- Detect complications
- Grading of lesion enhancement
  - mass effect
  - necrosis/bleed
  - cyst formation
  - definition

Post therapy
- Residual tumour
- Recurrent tumour
- Radiation effects
ROLE OF CT SCAN

- Initial investigation in non-specific complaints
- Differentiation between calcification and hemorrhage
- Status of adjoining bones / primary bone lesion
- Immediate post-operative status
- Multiple follow ups
ROLE OF CT SCAN
Role of MRI in evaluation of brain tumors

- Delineate size and extent of the tumor.
- Define the relationship of tumor to adjacent anatomical structures.
- Characterization of the tumors.
- Functional MRI-in pre operative planning.
- MRS-vital tool in differentiating malignant from non malignant entities.
TUMOR PROTOCOL

- Axial T1, T2
- Axial FLAIR
- Axial Gradient
- Coronal T2 / SOS Sagittal T2
- Diffusion
- Perfusion followed by post-contrast – all 3 planes
- Spectroscopy
- DTI +/-
Role of MRI contrast

- Better delineation and characterization of tumors
- Better visualization of mets isointense on non enhanced scans
- Estimating tumor grade
- Leptomeningeal involvement
- MR spectroscopy
contrast

- Contrast cannot always differentiate b/n tumor & edema

- Lack of enhancement does not signify lack of tumor
Look for ........

- Age of patient
- Site of tumor - Posterior fossa is a rare site for primary malignancy in adults
- Supratentorial, post fossa, sellar, pineal, intraventricular
Look for ........

- Intra vs extra axial
- Neoplastic vs non neoplastic
- Pathologic type
- Benign vs malignant
- Primary vs metastatic
- Grade of malignancy
- Mechanical effect
Intra vs extra axial

- Definitive – CSF cleft
- Bone involvement
- Relation to dura / invasion /
- Meningeal enhancement
- Buckling of cortex
- Vessels
Infiltrative vs localised / well marginated

- Margin
- Edema
- Homogeneity
- Relationship to adjoining structures
What is the consistency?

- Solid / firm
- Soft / early necrosis
Where is the epicentre?

- Helps to determine origin
Is there necrosis?
Is there hemorrhage?
Is there haemorrhage?

- Primary – GBM, anaplastic oligodendroglioma, ependymoma

- Metastases – melanoma, RCC, choriocarcinoma, breast cancer, lung cancer, thyroid cancer
Is there a cyst?

- Fluid debris levels
Fat- Ruptured dermoid

hypervascularity
PEDIATRIC IMAGING
Special Issues

• Sedation
• Spinal Imaging = Longer scan time
• Movement inspite of sedation
• Normal variants and appearances
POSTERIOR FOSSA TUMORS

- Midline
- Hemispheric
- Brain stem
- Exophytic
POSTERIOR FOSSA TUMORS- symptoms

- Midline - Raised ICT – vomiting headache
- Hemispheric – Cerebellar signs
- Brain stem – Cranial nerve palsies
- Exophytic – Cranial nerve palsies
Medulloblastoma

- Vermian location. Occasionally cerebellar hemispheric
- Well circumscribed, spherical
- Hemorr, cysts, Ca+ uncommon
- High nuclear-cytoplasmic ratio
Laterally placed / Cyst formation  Lack of significant enhancement
Brain Stem Gliomas

- Fibrillary and pilocytic

Medullary
Pontine
Mesencephalic

Focal Diffuse
Diffuse pontine with exophytic component
Tectal Plate Glioma

- Small lesions
- Hydrocephalus
SUPRATENTORIAL TUMORS

Supratentorial

Cortical

In relation to ventricles

Intraventricular

Deep parenchymal
SUPRATENTORIAL TUMORS

Supratentorial

Cortical - seizures

In relation to ventricles – Raised ICT

Intraventricular – SGCA, CPP, Epen

Deep parenchymal – Neurological deficits
Supratentorial Tumors

Supratentorial

Cortical Solid - DNET, low grade astrocytoma
Cortical Cystic - Pilocytic, Ganglioglioma, PXA

In relation to ventricles - ependymoma
Intraventricular - SGCA, CPP, Epen
Deep parenchymal - PNET
SUPRATENTORIAL TUMORS

Midline

Pineal Region - Raised ICT, neurological deficit

Suprasellar – Visual / Endocrine symptoms
SUPRATENTORIAL TUMORS

Midline

Pineal Region - PNET, Germ cell tumor

Suprasellar – Visual pathway glioma, Craniopharyngioma, Germ cell tumor
PILOCYTIC ASTROCYTOMA
DNET

- Partial seizures.
- Associated cortical dysplasia.
- DNET can have calcification and contrast enhancement.
- Intracortical lesion located in temporal lobe
- Calcification 20%
- MR: hyperintense on T2W, well demarcated and lack of peritumoral edema.
LOW GRADE GLIOMA
INTERMEDIATE
GRADE GLIOMA
GLIOBLASTOMA MULTIFORME
GLIOMATOSIS CEREBRI
OLIGODENDROGLIOMA
SUPRATENTORIAL PNET
LYMPHOMA
MENINGIOMA

- Sharp tumor-brain interface
- Spherical / en plaque
- Dural attachment
- Necrosis, hemorrhage, CENTRAL SCAR
SUPRATENTORIAL
INTRAVENTRICULAR
SUPRATENTORIAL EPENDYMOMA
CENTRAL NEUROCYTOMA
CHOROID PLEXUS PAPILLOMA
GIANT CELL ASTROCYTOMA
Intraventricular astrocytoma
SUPRATENTORIAL MIDLINE
CHORDOID GLIOMA
Pituitary tumors
Craniopharyngioma

50% of cases occur in first and second decade
a) Hypothalamic – 75%
b) Supra and intrasellar – 25%
c) Only intrasellar – 4%
Pre fixed or post fixed
CRANIOPARYNGIOMA
Pineal Region

- Pineoblastoma
- Pineocytoma
- Germ cell tumor
Pineal Tumor
METASTASES
METASTASIS
SKULL BASE LESIONS

- Chordoma
- Other bone tumors
Post treatment evaluation

- Detailed history – type of Rx?
- What symptoms prior to Rx?
- How much was the response to Rx?
- Current symptoms? Persistent or new?
- Time since start and completion of Rx?
POST - SURGERY

Within 48 hrs –
before post-op changes manifest

Goal of imaging

• Delineate residue
• Delineate post-operative parenchymal defect
• Extended for an incomplete study – spinal imaging
Treatment changes in the tumor bed

Recurrence
Appearance of a new lesion after radiation treatment
DIFFICULTIES
EARLY GBM

FOLLOW UP
ROLE OF MR SPECTROSCOPY

- Non diagnosed focal lesions
- Confirm diagnosis in diffuse lesions
- Avoided biopsies
- Help superspeciality clinics
- New discovery
Avoided biopsies
MRI + MRS = metabolic mapping.
ROLE OF DIFFUSION

- Acute infarct vs tumor
- Abscess vs primary tumor
ROLE OF PERFUSION IMAGING
ROLE OF PET

- False negatives – PET consistent with radiation necrosis, yet subsequent progression of tumor

- False positive in cases of radiation injury which activates repair mechanism

- Expensive and lack of availability

- Decrease in metabolic activity in viable tumors in the immediate postradiation period
Summary

- Radiological assessment based on morphology
- Newer functional MRI techniques can potentially be used to assess “tumor behaviour”
- Take into account age, clinical history and location
INTERACTION

- NEUROSURGEON
- RADIOLOGIST
- ONCOLOGIST
- PATHOLOGIST

Clinical status
Site of biopsy – multiple areas
Specific queries
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