IMAGING OF INTRACRANIAL INFECTIONS

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Plan

- Introduce MR sequences that are useful in the diagnosis of intracranial infections
- Learn a systematic approach for the interpretation of imaging findings
- Review a series of cases

NEUROINFECTIONS

Several outbreaks of encephalitis in this century
ebola, zika

In endemic areas, common cause of neurological morbidity
tuberculosis, cysticercosis

Urbanization and encroachment on natural environments, ease of world travel and climate change
mosquito-borne diseases - malaria, dengue, and viral encephalitides

Immunosuppressed and immunodeficient states
post-transplant, chemotherapy, disease modifying therapy, recreational drug use, HIV

Transmissible virus and protein particles
prion

CNS INFECTIONS: APPROACH

Supporting Clinical features, background info and laboratory findings
- rash, travel or therapy, CSF, CD4 counts

Pathogens
- location of infection within the CNS, geographic exposures, vaccination status, age, surgery and immune suppression

Imaging of neuraxis to include spinal cord and caudal equina
- extent of involvement ; multifocal, diffuse, atypical clinical or CSF findings

Choice of Tools and Tricks
- diagnosis and monitoring

ROLE OF IMAGING

- LOCATION AND EXTENT OF INVOLVEMENT
- TYPE OF INFECTION
- DETECTION OF COMPLICATIONS
- GUIDANCE TO BIOPSY OR THERAPY
- RESPONSE TO THERAPY

INTRACRANIAL INFECTIONS

CALVARIAL

Osteomyelitis

MENINGEAL

Leptomeningeal
Pachymeningeal
Arachnoiditis
Effusions
Empyema

VENTRICULAR

Choroid Plexitis
Hydrocephalus
Pneumocephalus
Ventriculitis

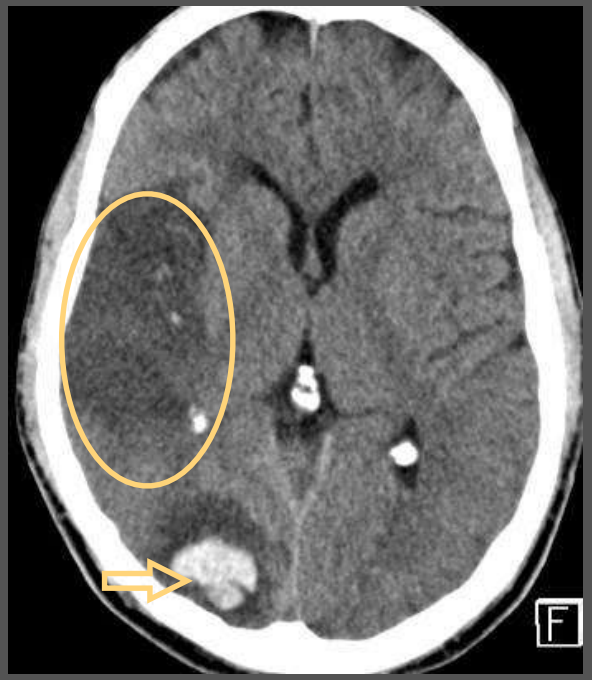
PARENCHYMAL LESIONS

Encephalitis / Myelitis
Cerebritis
Abscess
Cysts
Granuloma

Gliotic scar
Calcification

Infarcts -arterial or venous
Haemorrhages

septic embolism



acute blood products

acute invasive aspergillosis

mineralisation

cysticercosis

calcification

CT

MR CONTRAST MECHANISMS

Endogenous

relaxation (T1 ; T2; T2*)

diffusion (DWI, DTI)

susceptibility (T2*,SWI)

flow (MRA, ASL, CSF flow)

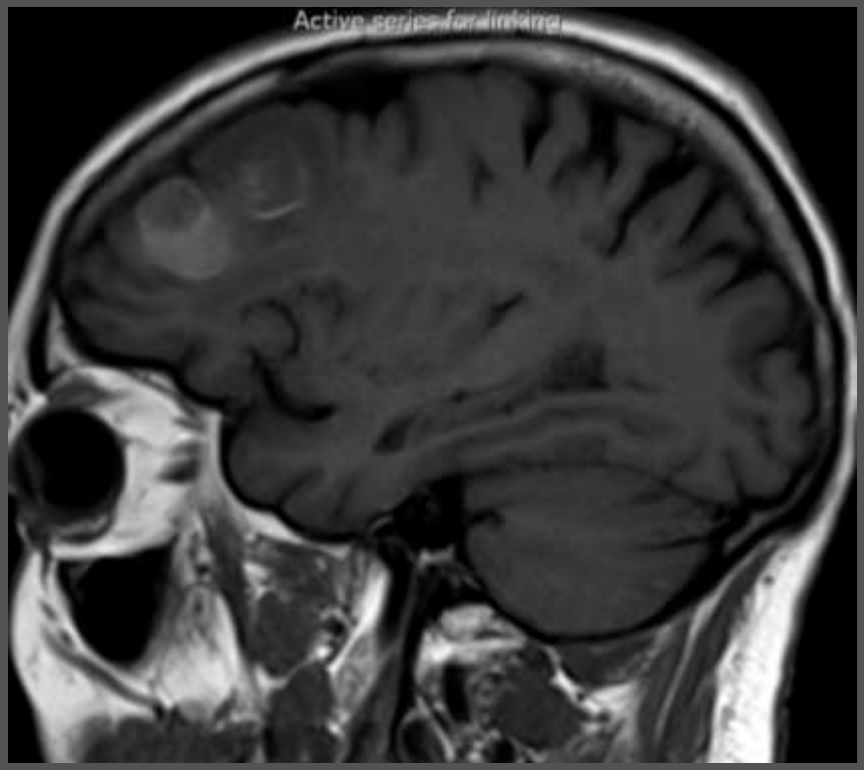
perfusion (DCE, DSC, ASL)

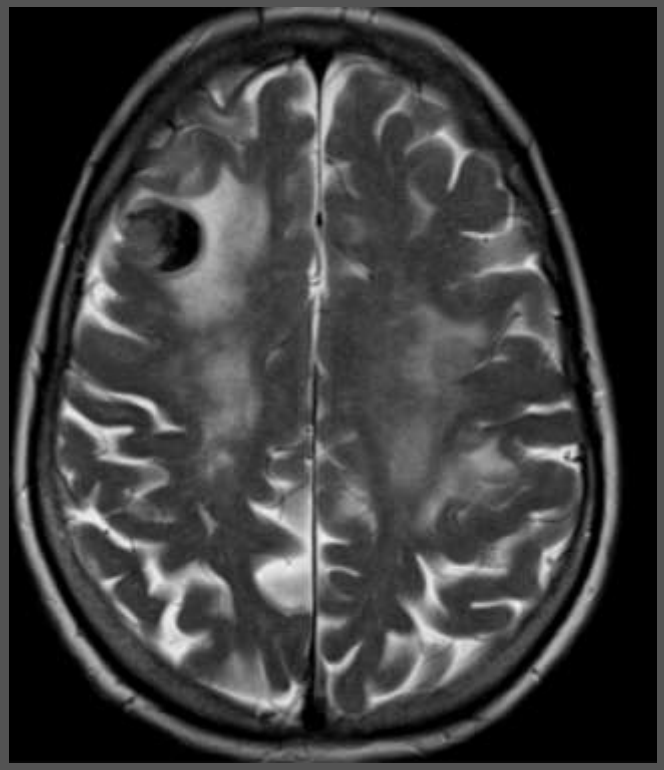
BOLD (fMRI)

Exogenous

Gd -chelating agents (BBB, perfusion)

J. Magn. Reson. Imaging 2007;26:823–837.





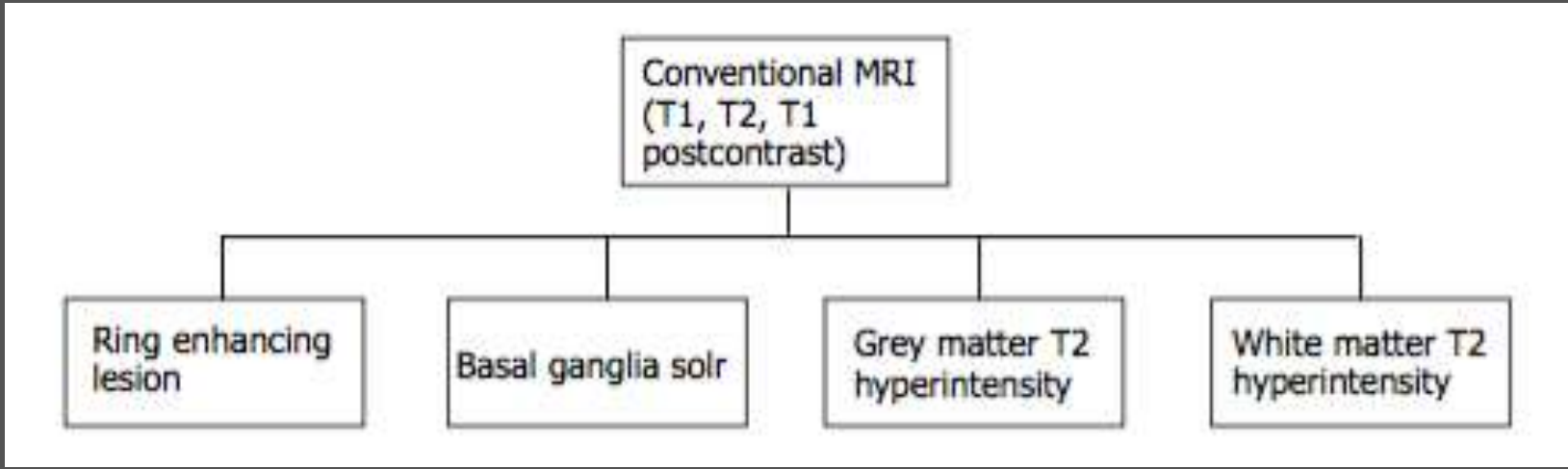
T1-weighted hyperintense signal

- **F**at
- proteinaceous **f**luid
- Melanin
- Methaemoglobin
- Mineralisation (manganese, copper)
- gadolinium

T2-weighted hypointense signal

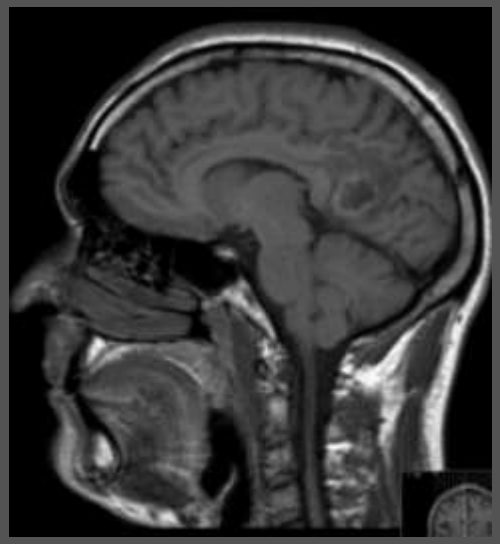
- Fat
- Melanin
- early methaemoglobin
- Colloid
- calcium

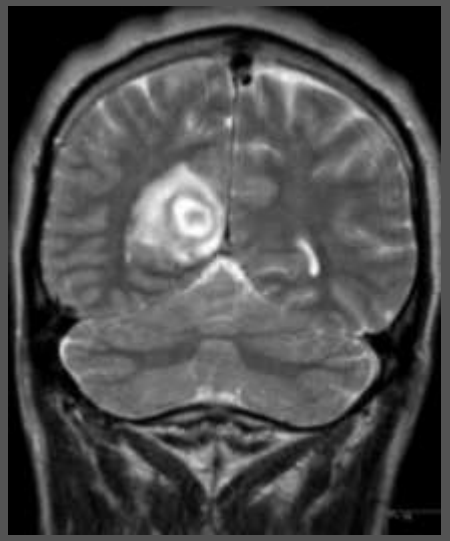
PARENCHYMAL DISEASE

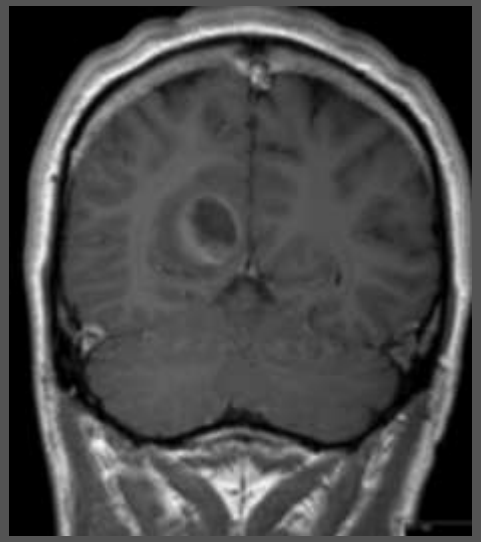


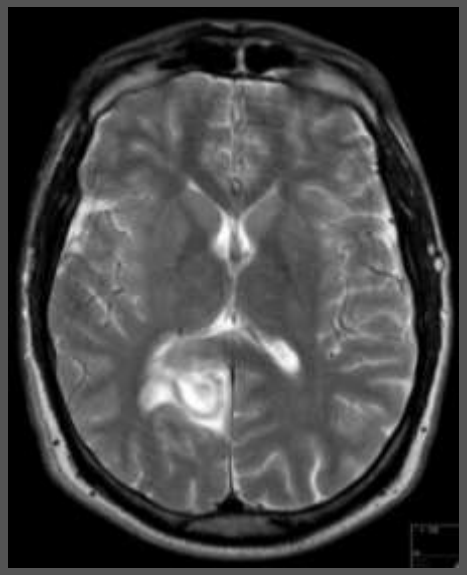
WJR 2014; 28; 6(9):716-725

ABSCESS

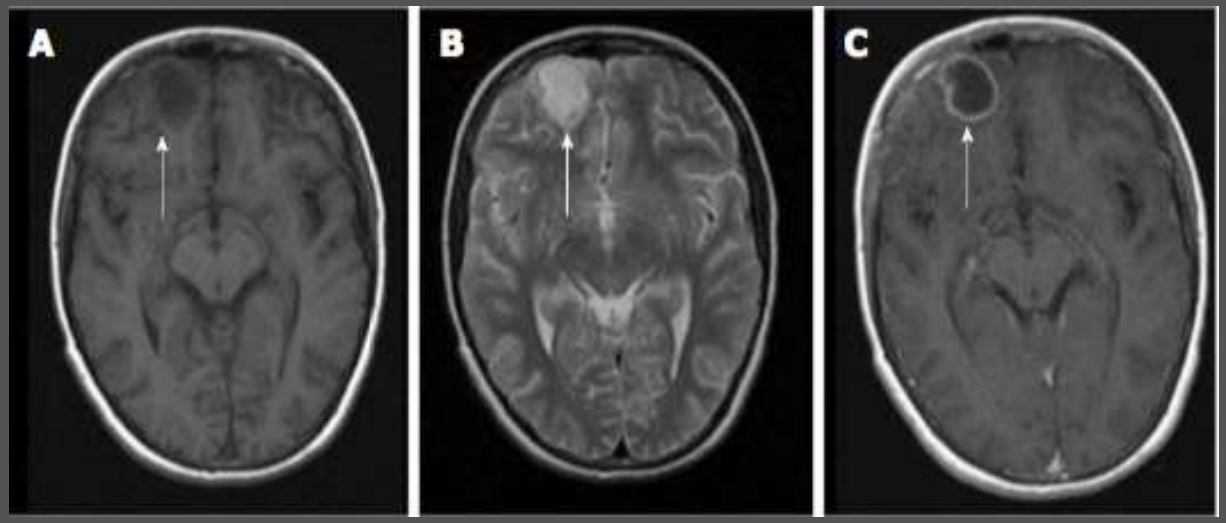




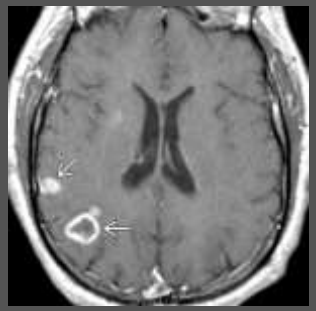




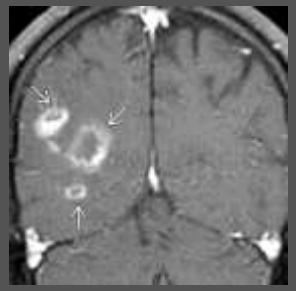
BRAIN ABSCESSES



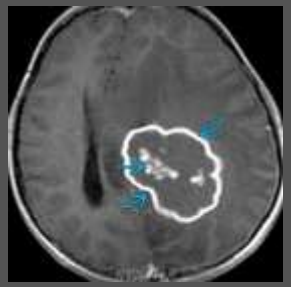
Bacterial



Tuberculoma

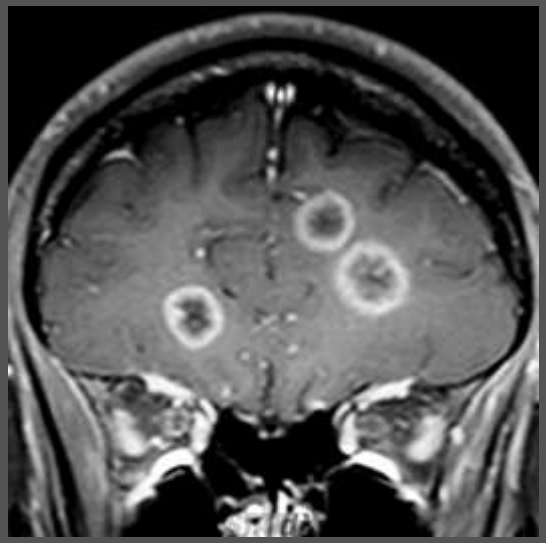


Toxoplasmosis

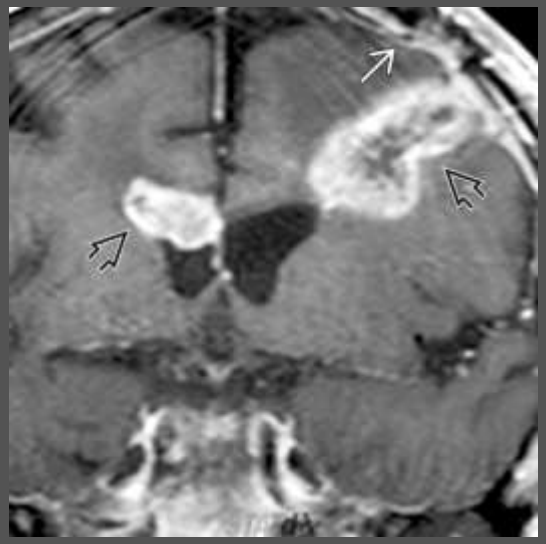


TB

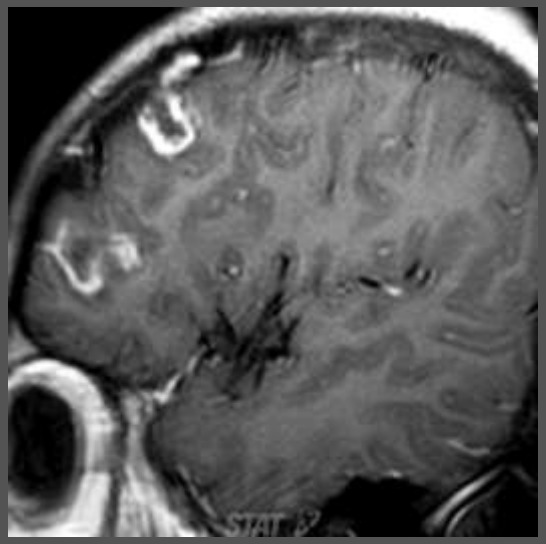
RING ENHANCING LESIONS



Metastases

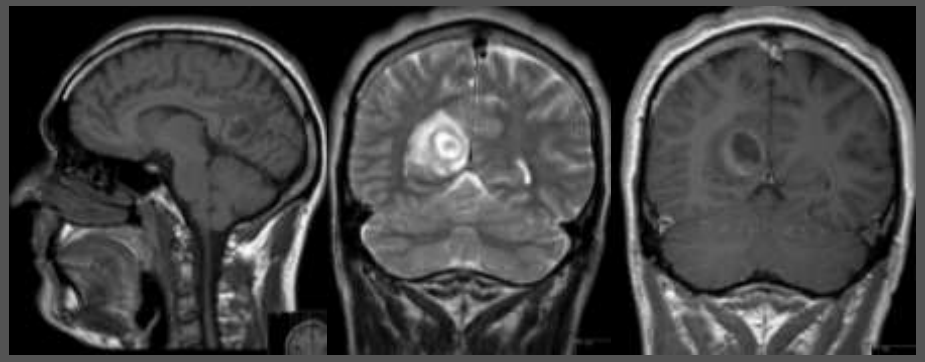


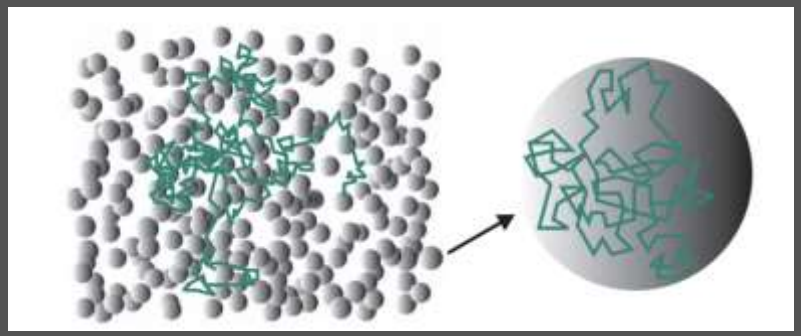
GBM

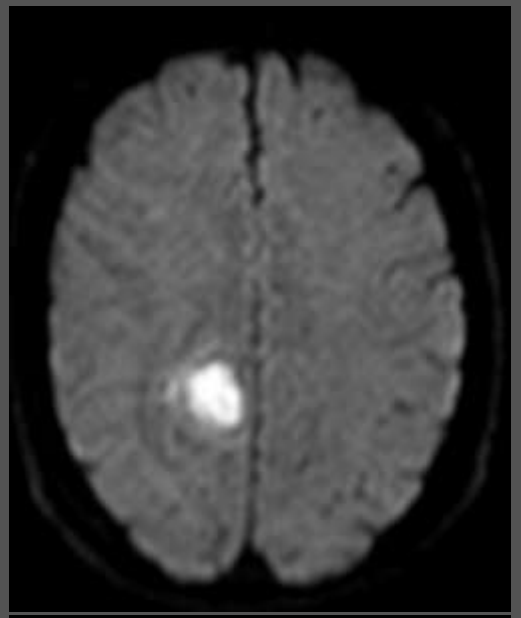


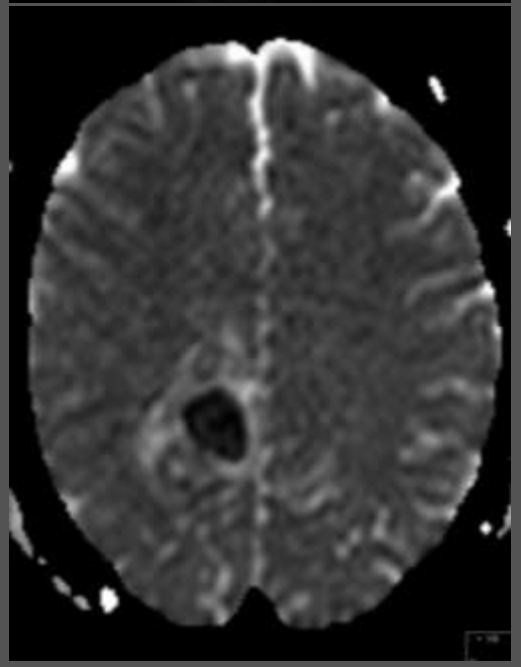
Infarction

ABSCESS - DWI

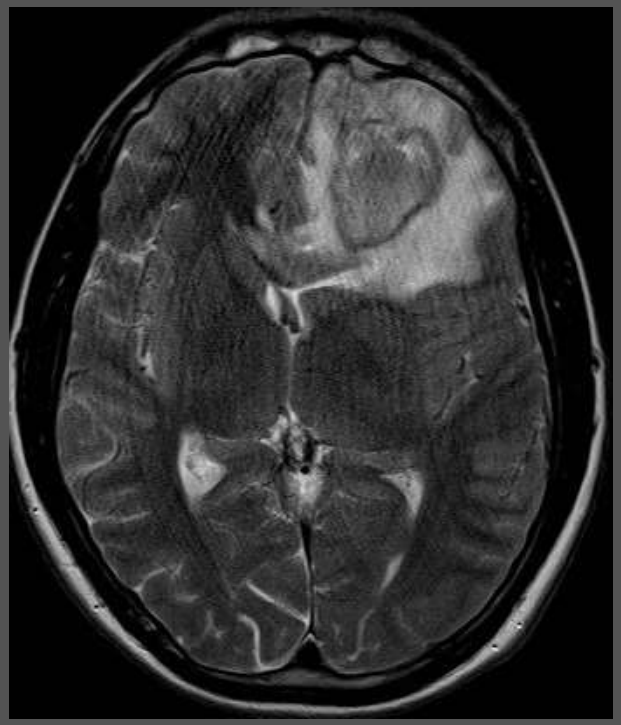


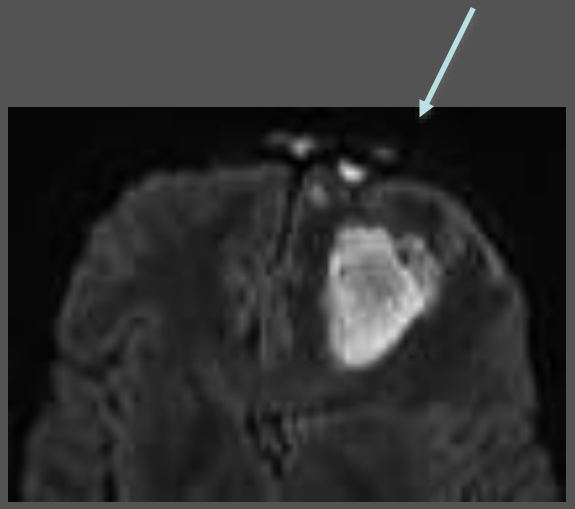


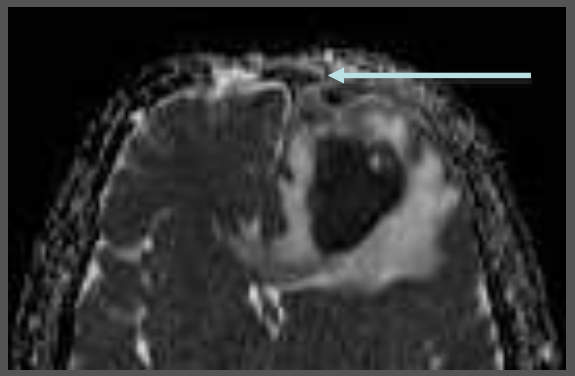




ABSCESS : sinogenic



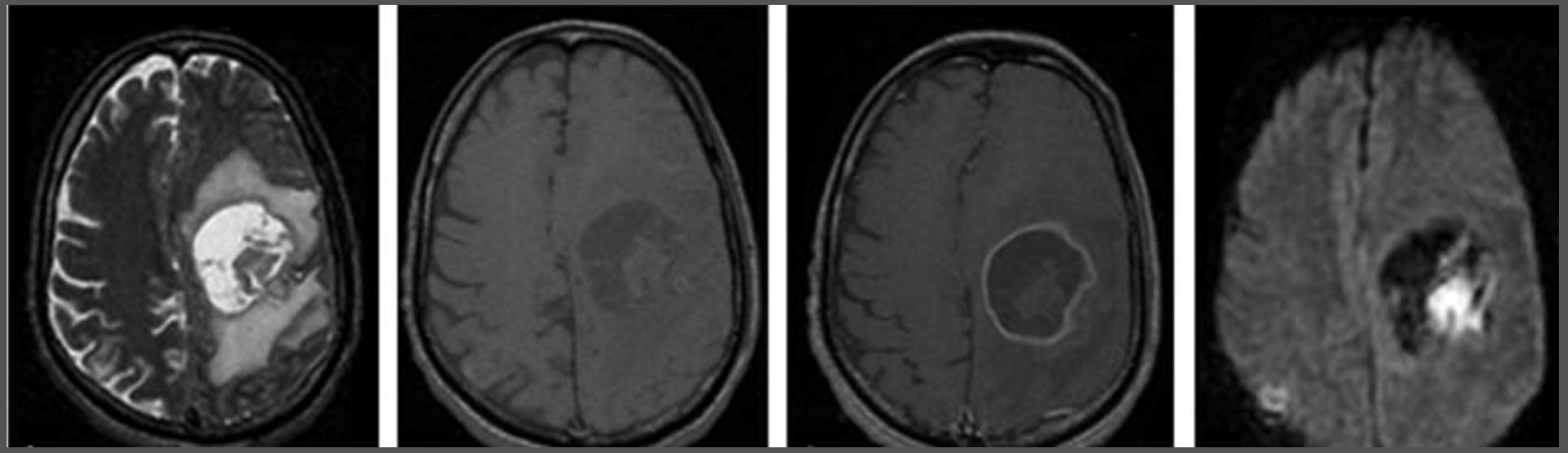




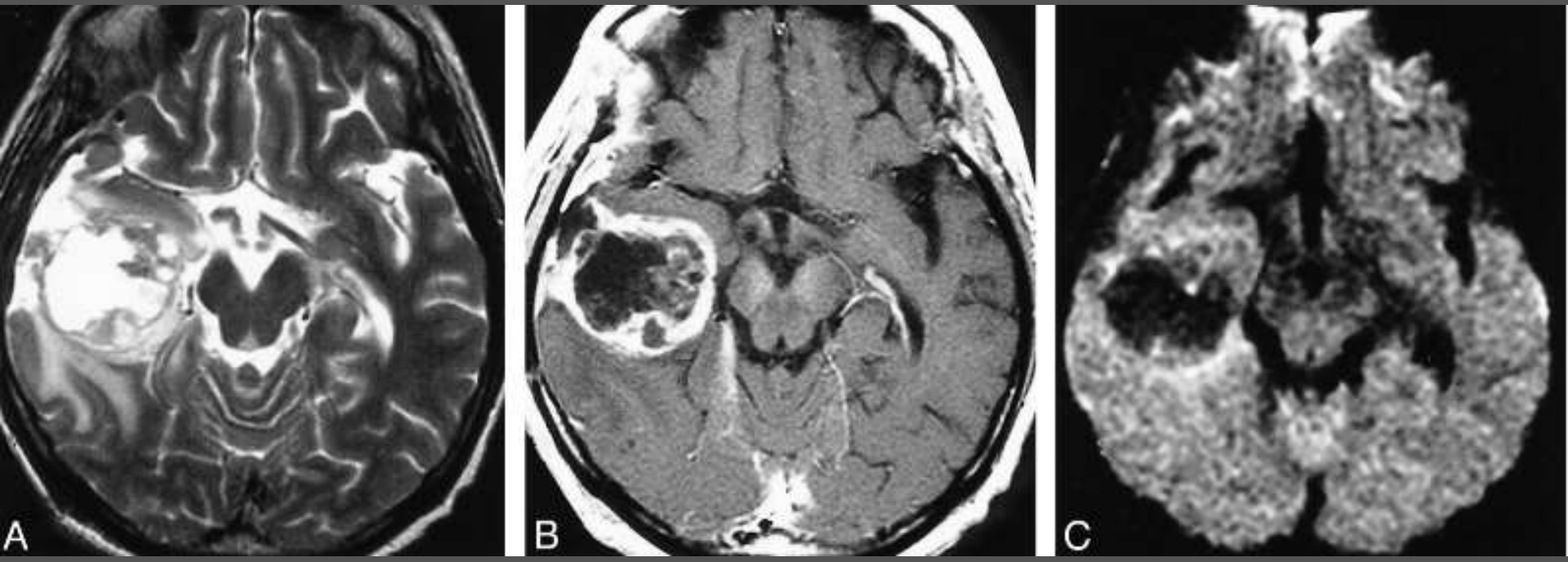
FRONTAL SINUSITIS → EMPYEMA → CEREBRAL ABSCESS

Restricted diffusion due to highly viscous material within the abscess

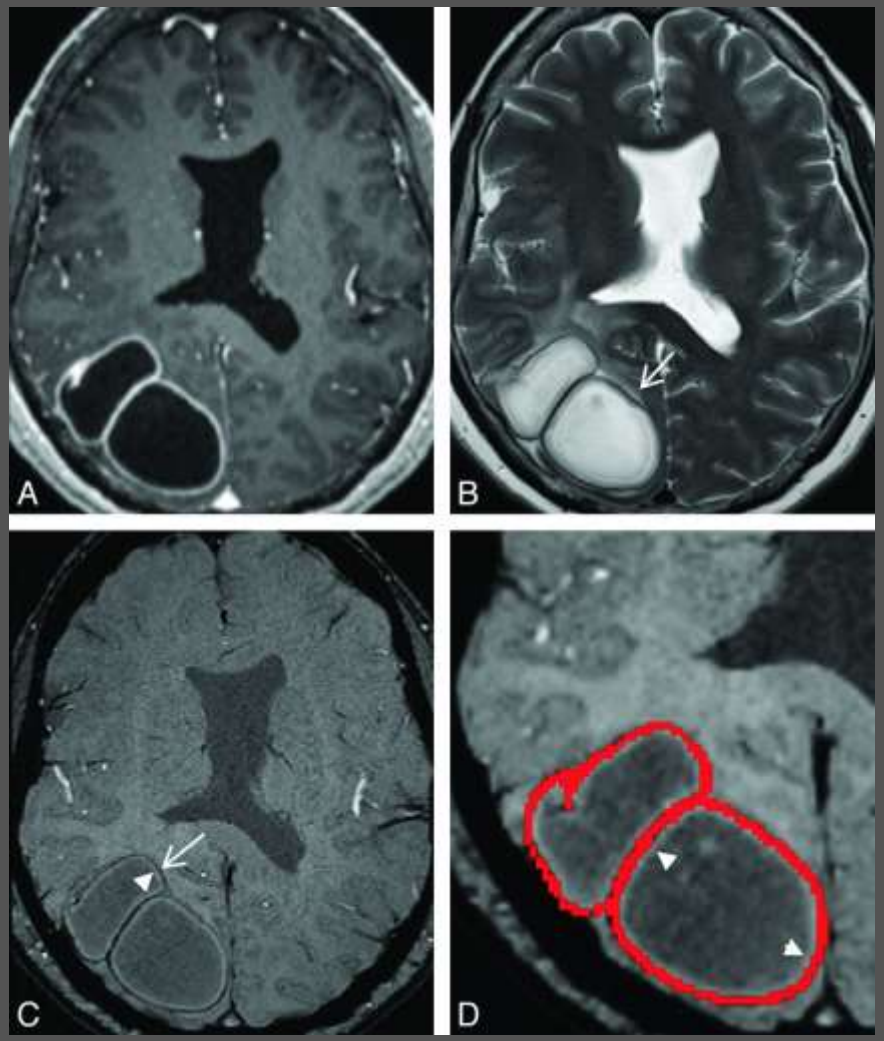
DWI - FUNGAL ABSCESS – INTRACAVITARY PROJECTIONS



ABSCESS VS GBM

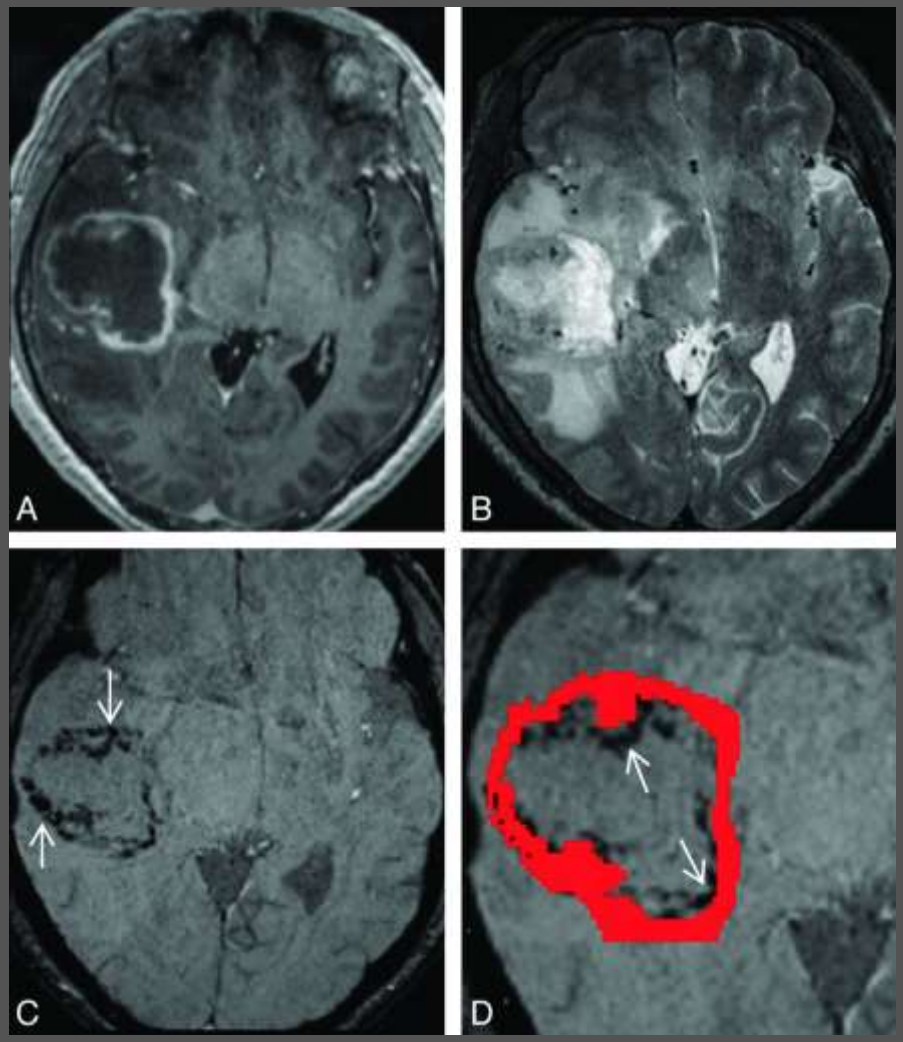


SWI- ABSCESS



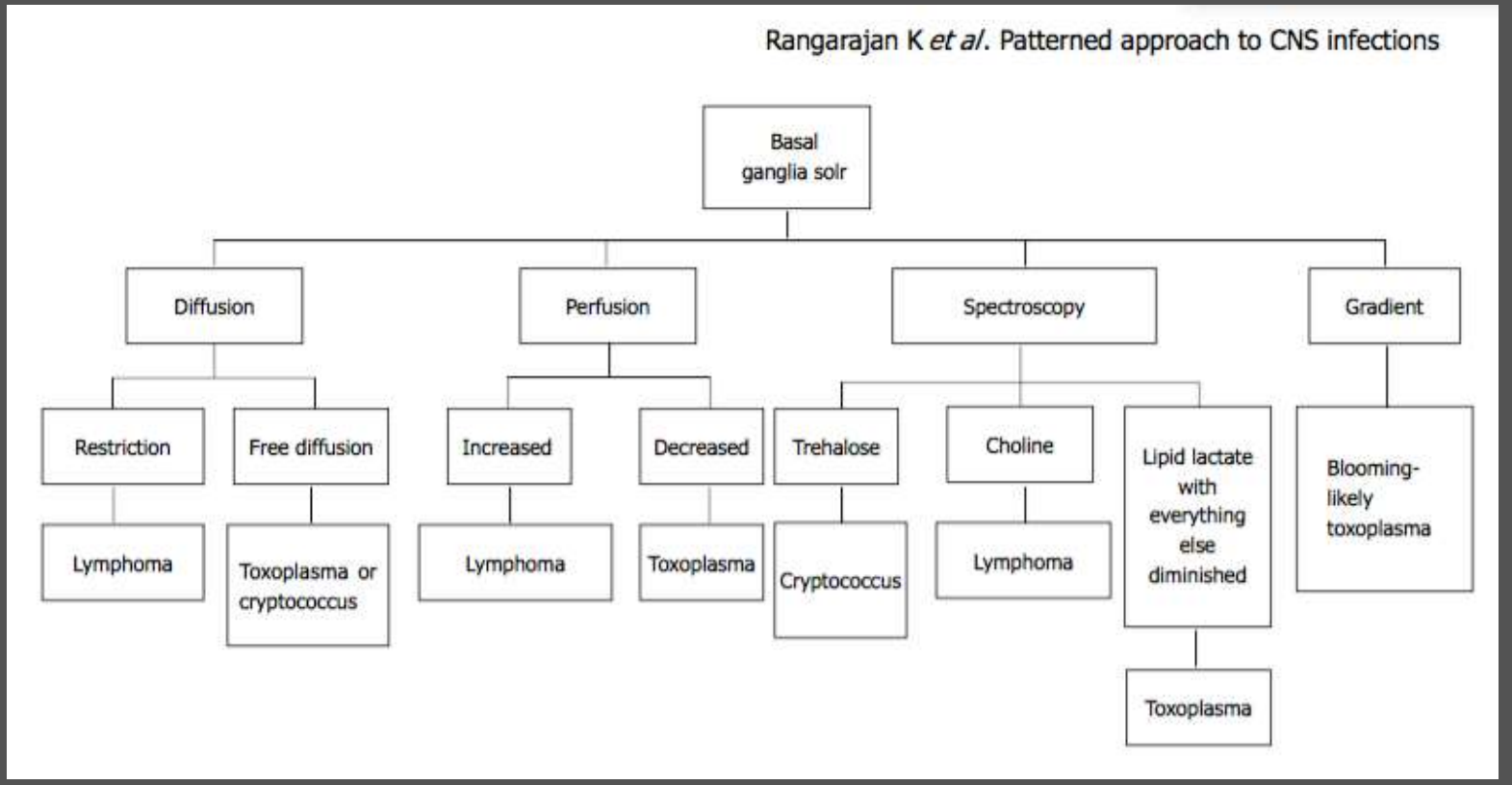
Toh C et al. AJNR Am J Neuroradiol 2012;33:1534-1538

A 57-year-old man with a right temporal necrotic glioblastoma.

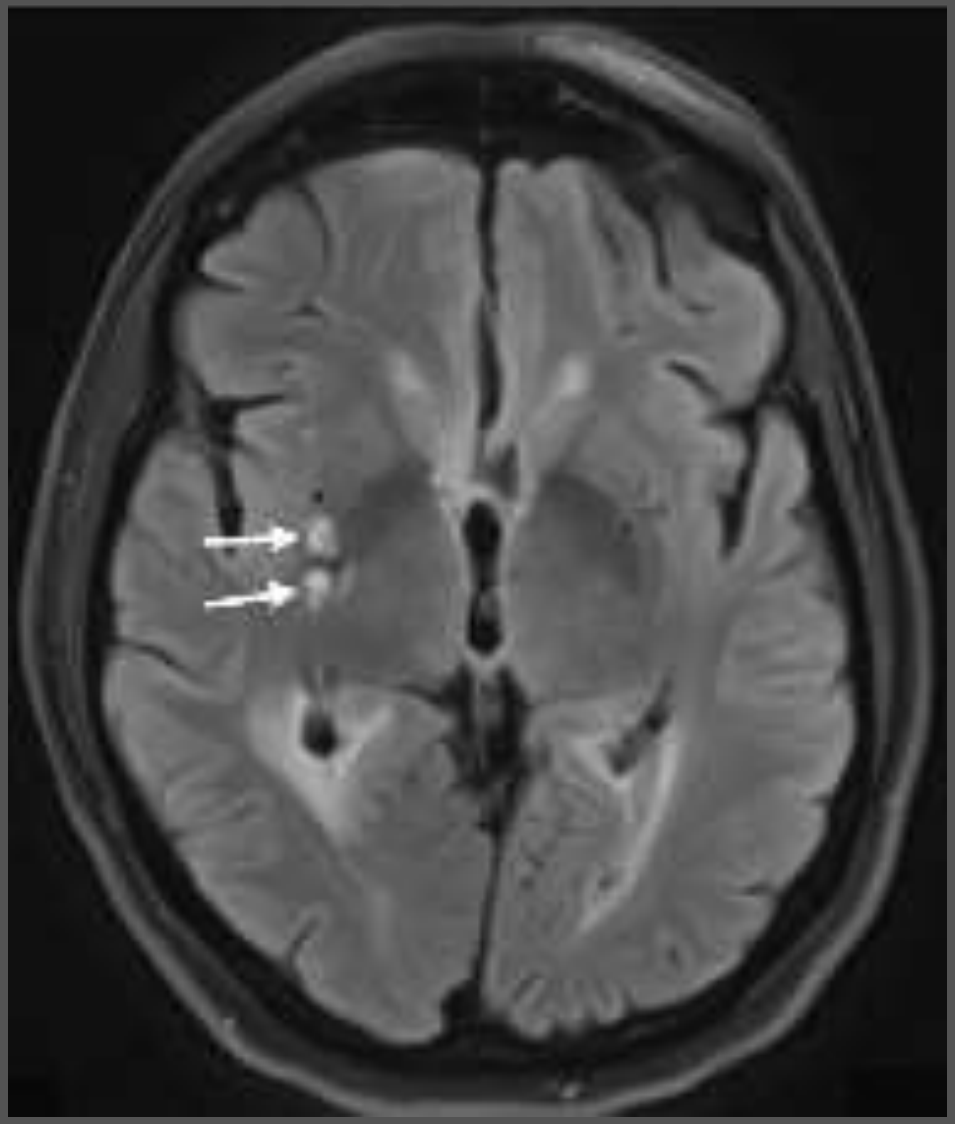


Toh C et al. AJNR Am J Neuroradiol 2012;33:1534-1538

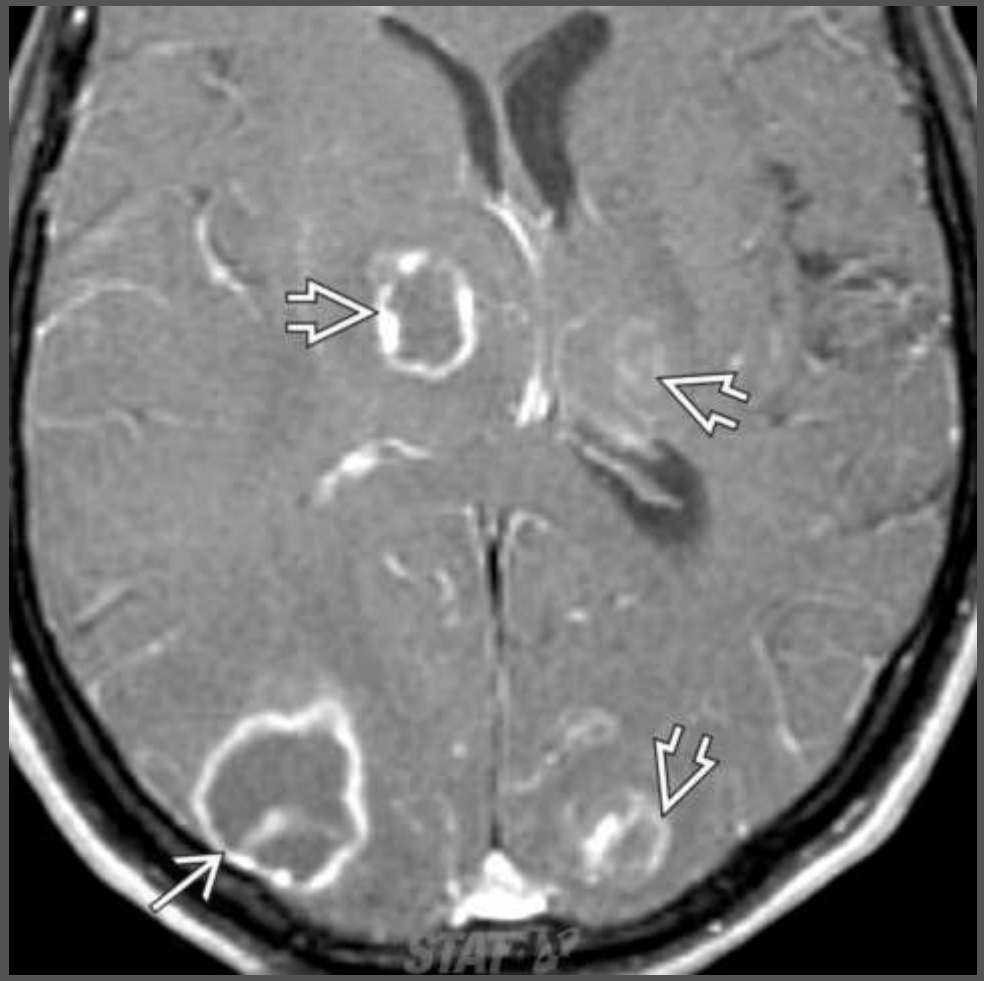
BASAL GANGLIA SOL



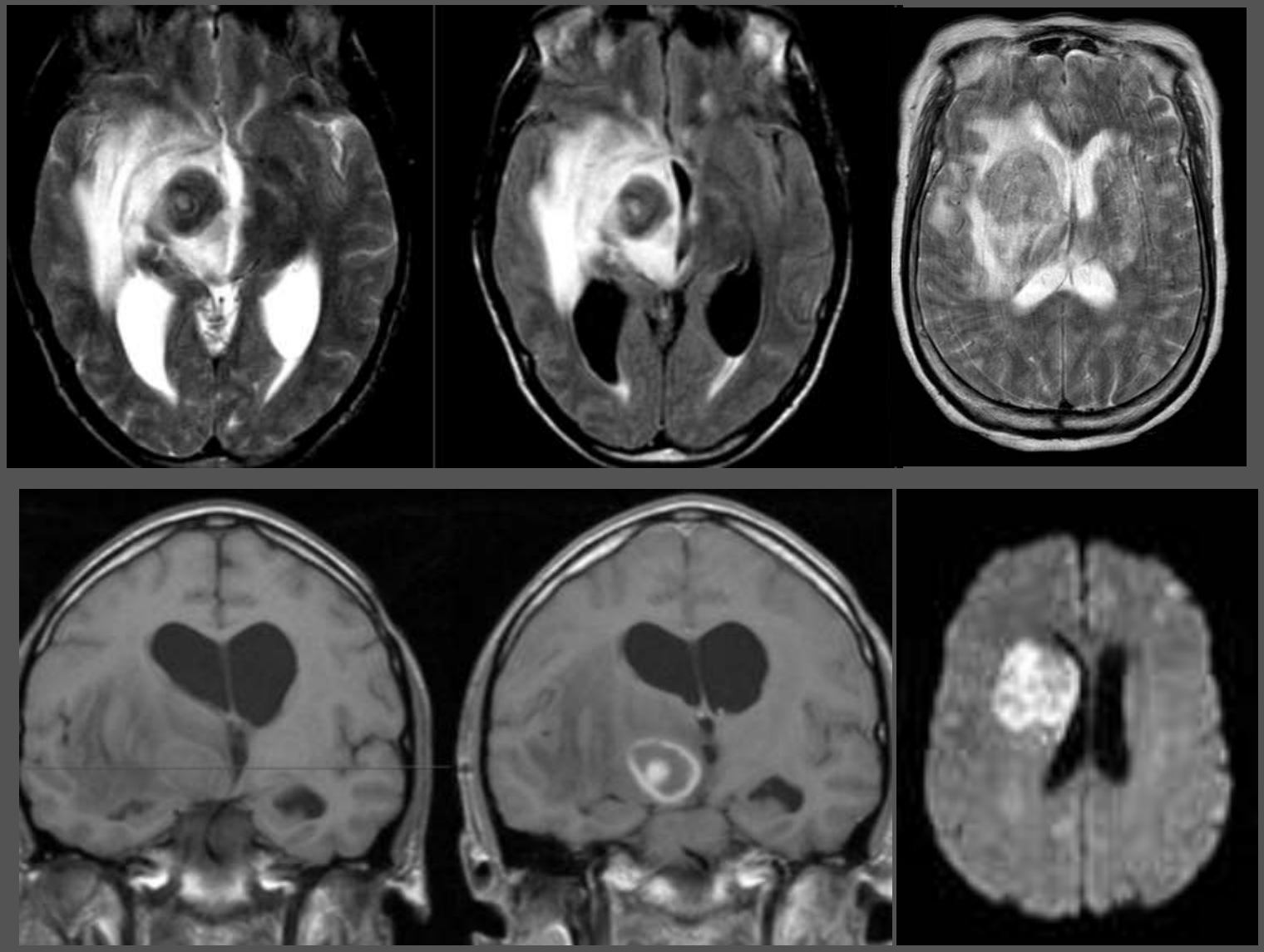
BASAL GANGLIA INVOLVEMENT - CRYPTOCOCCUS



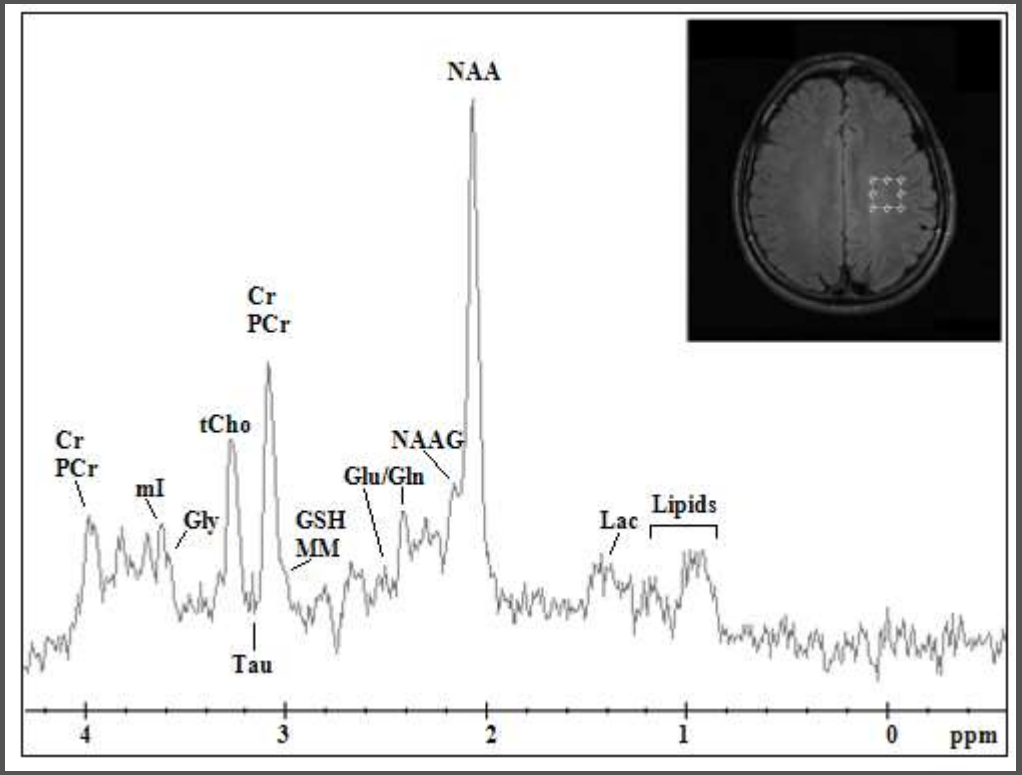
BASAL GANGLIA INVOLVEMENT - TOXOPLASMOSIS



BASAL GANGLIA INVOLVEMENT - TOXOPLASMOSIS

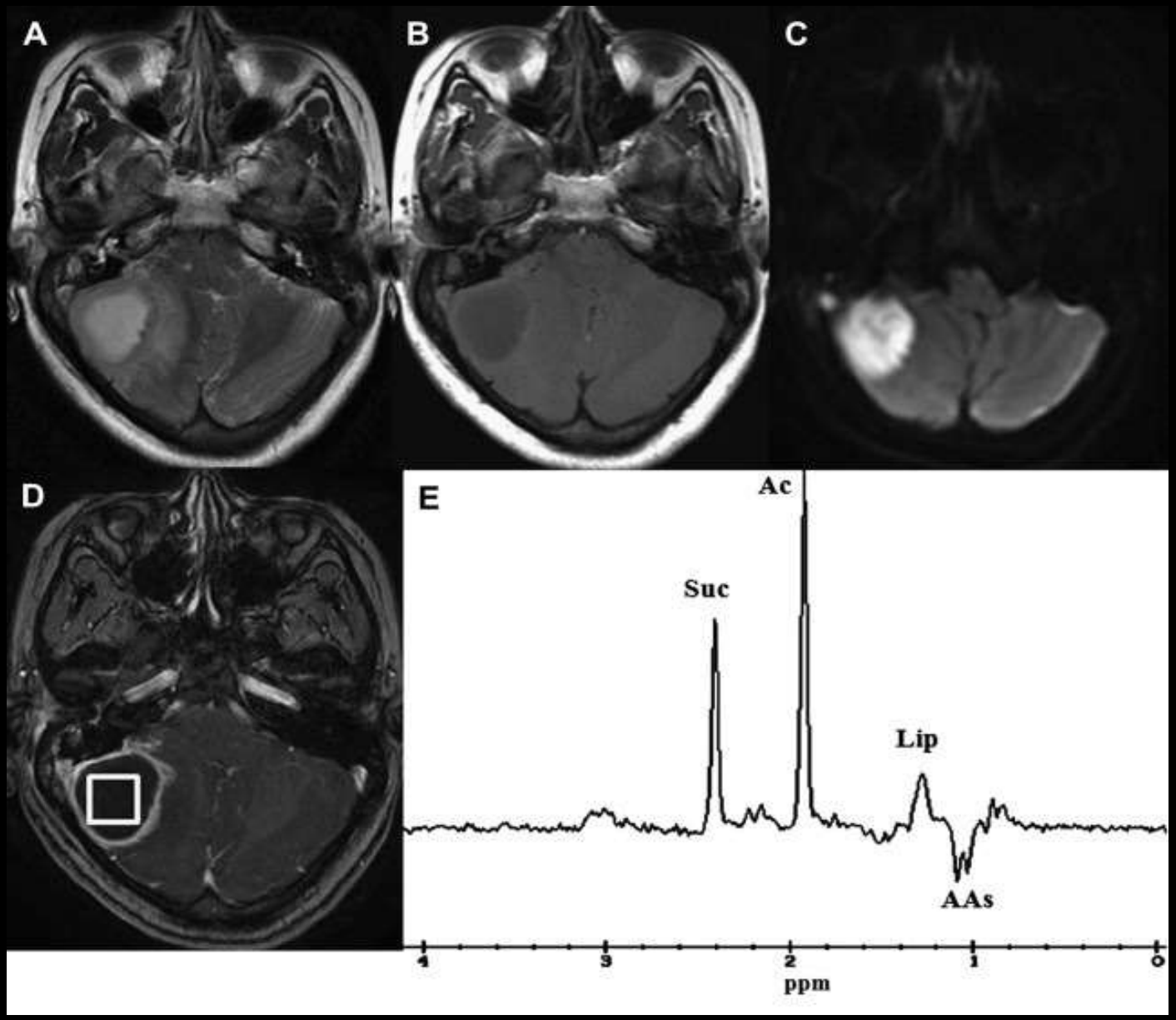


SPECTROSCOPY



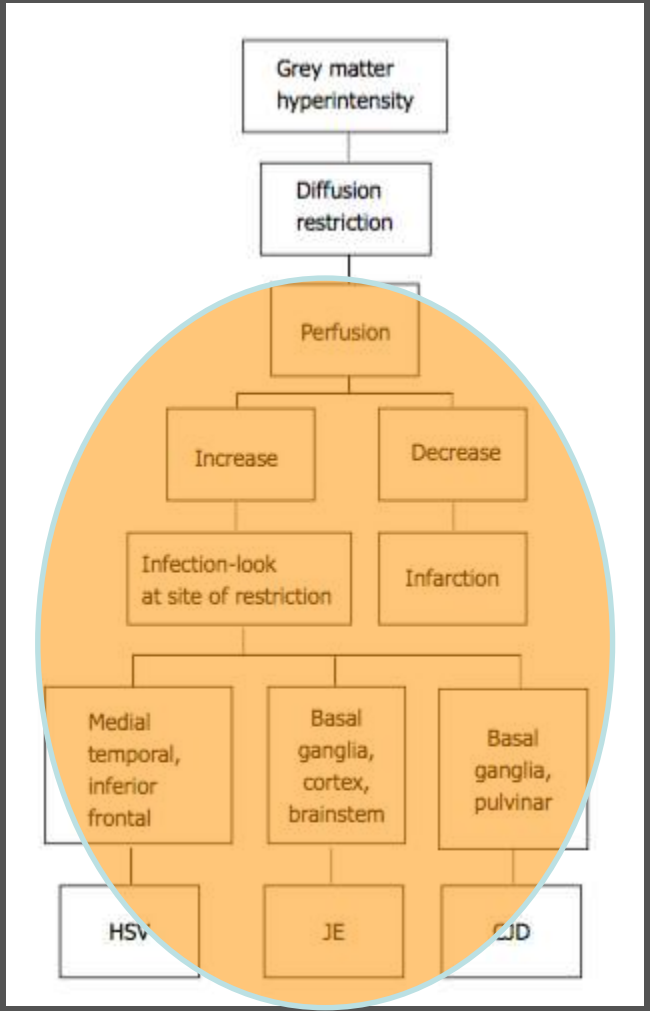
Observable Proton Metabolites

ppm	Metabolite	Properties
0.9-1.4	Lipids	Products of brain destruction
1.3	Lactate	Product of anaerobic glycolysis
2.0	NAA	Neuronal marker
2.2-2.4	Glutamine/GABA	Neurotransmitters
3.0	Creatine	Energy metabolism
3.2	Choline	Cell membrane marker
3.5	*myo*-inositol	Glial cell marker, osmolyte hormone receptor mechanisms
1.2	Ethanol	Triplet
1.48	Alanine	Present in meningiomas
3.4&3.8	Glucose	Increased in diabetes
3.8	Mannitol	Rx for increased ICP

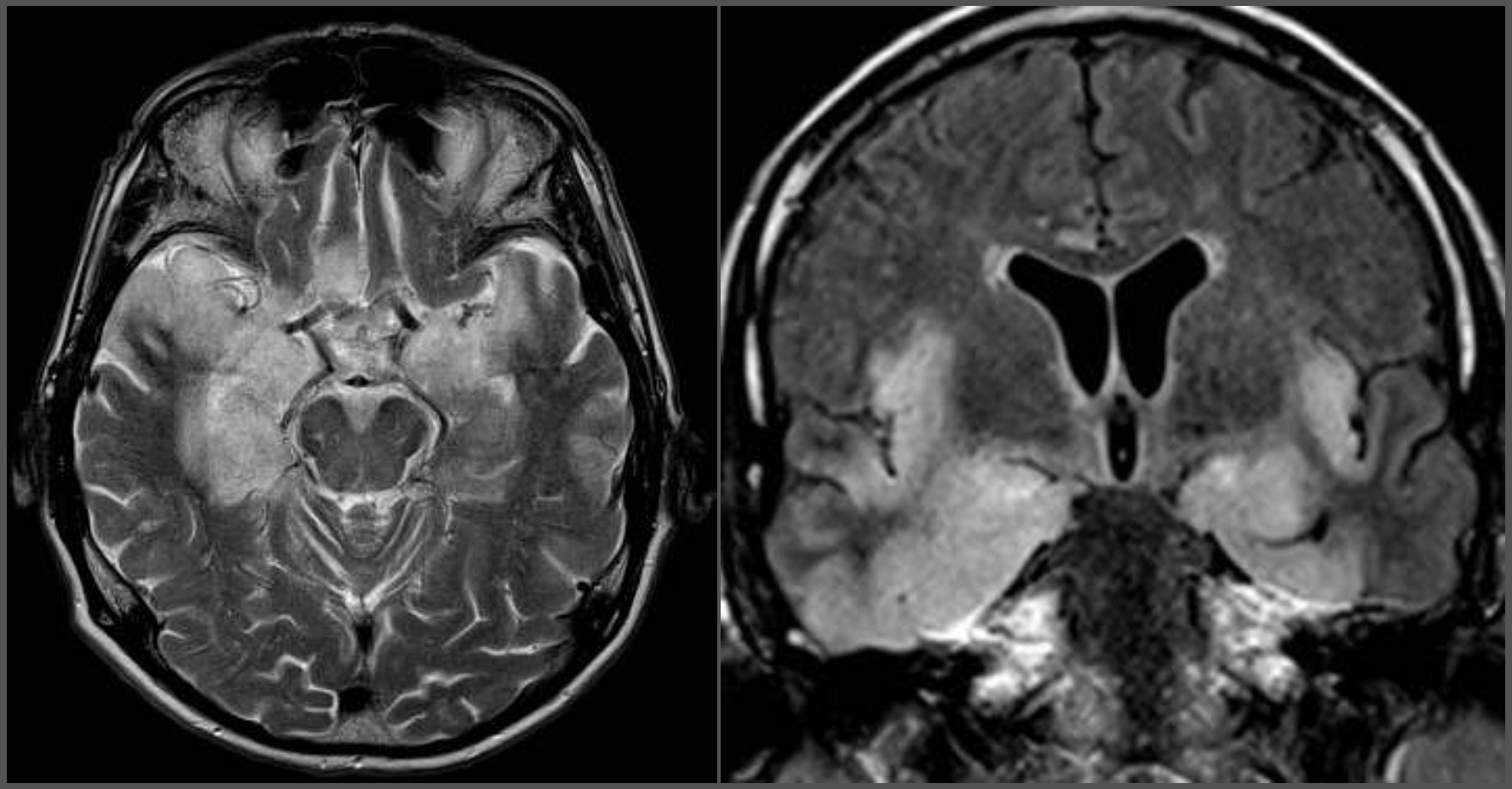


MR Spectroscopy in Brain Infections Neuroimaging Clinics of North America, 23, 3, 2013, 475 - 498

GRAY MATTER - ENCEPHALITIS



HERPES SIMPLEX ENCEPHALITIS



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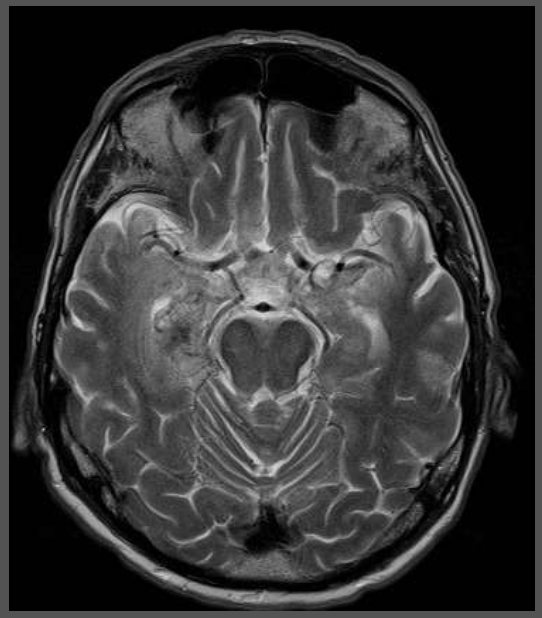
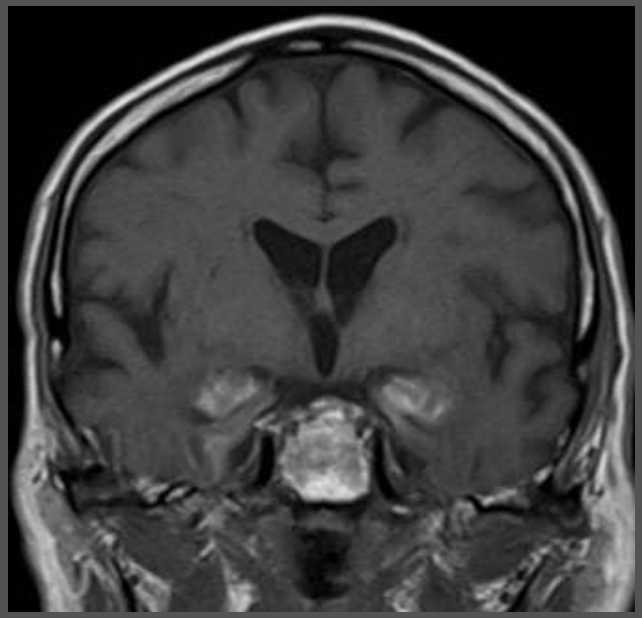
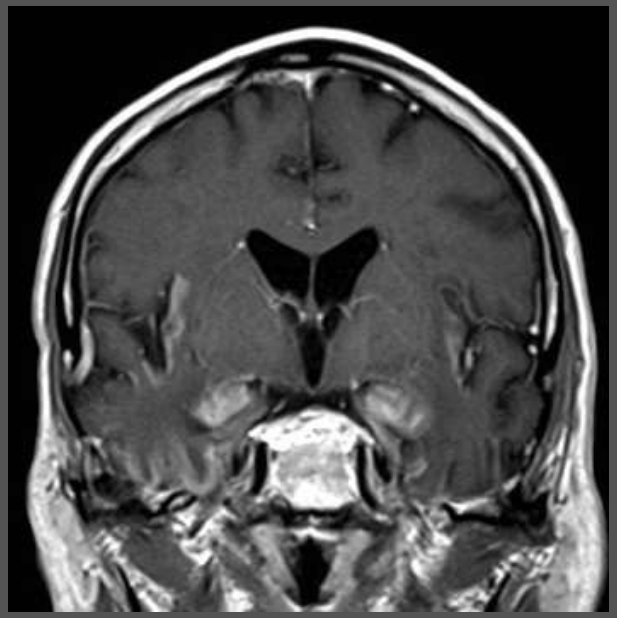
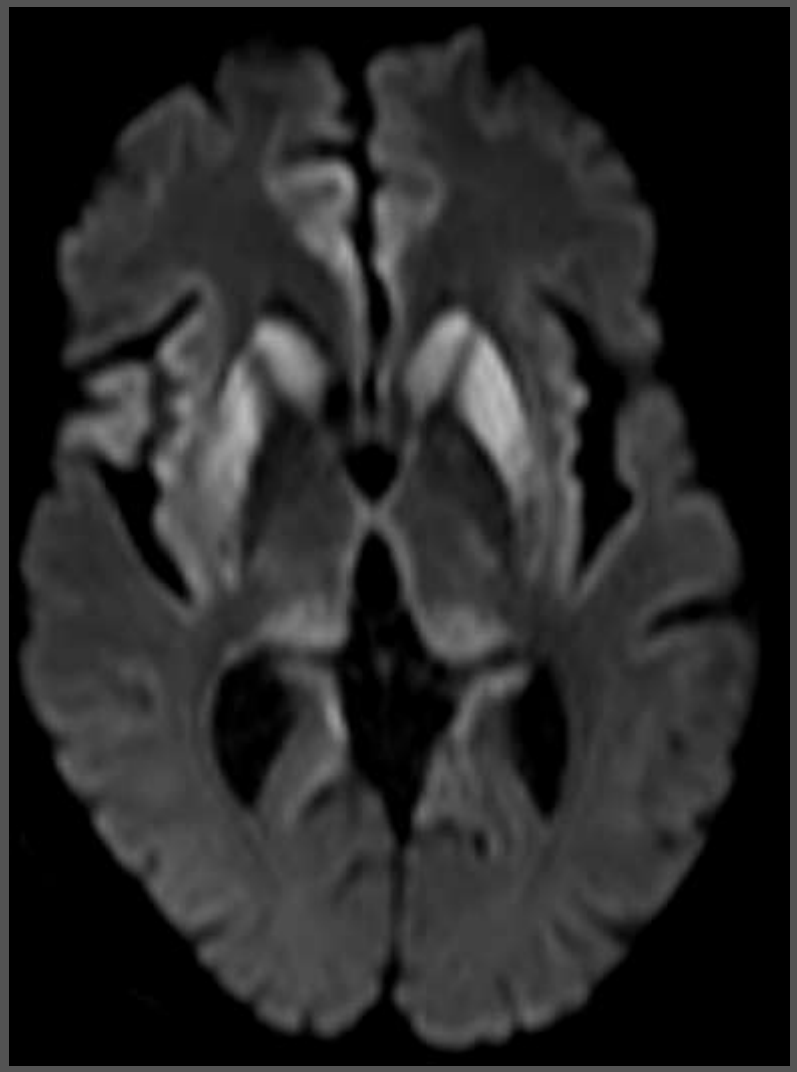
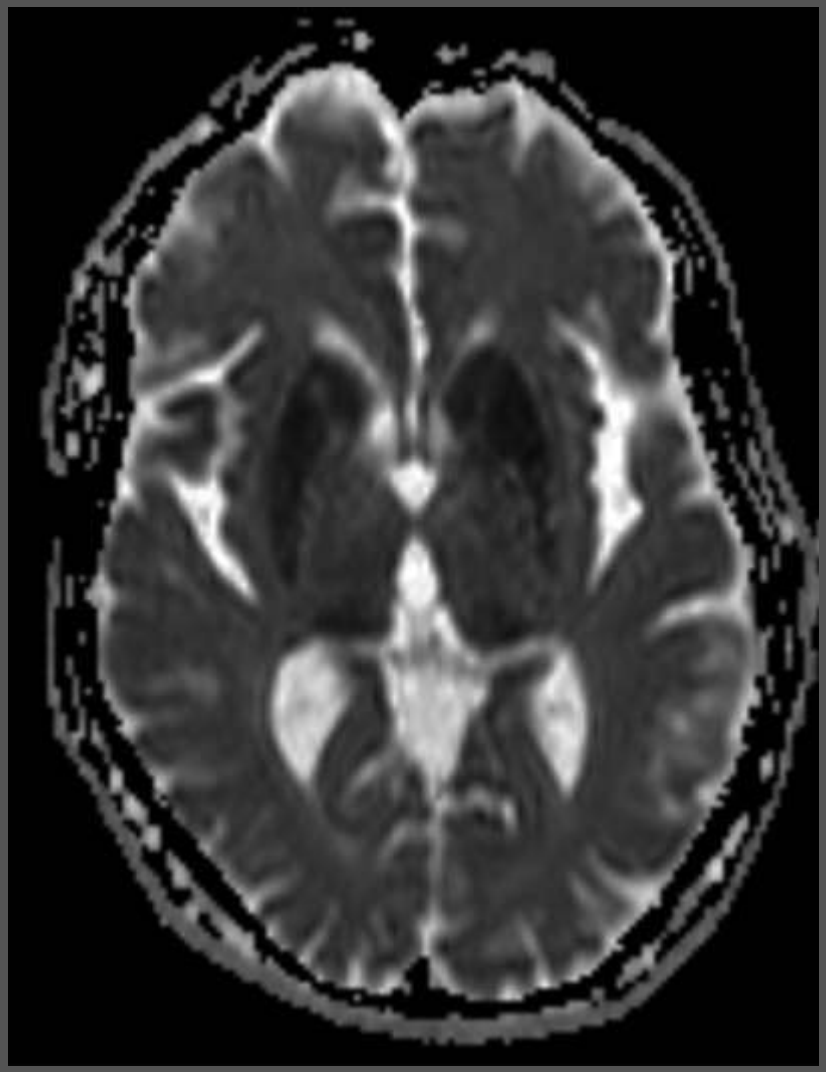




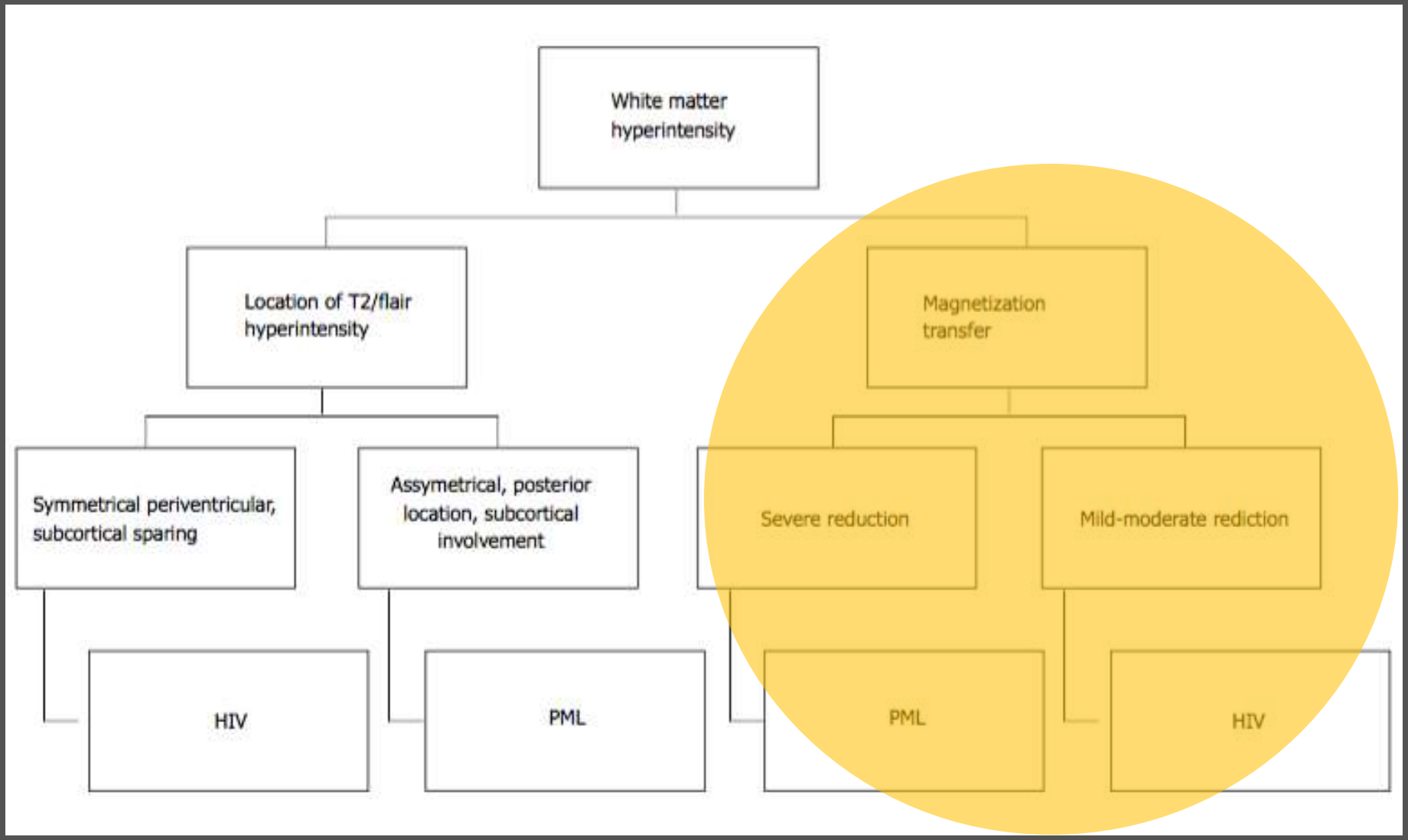


CREUTZFELDT -JAKOB DISEASE

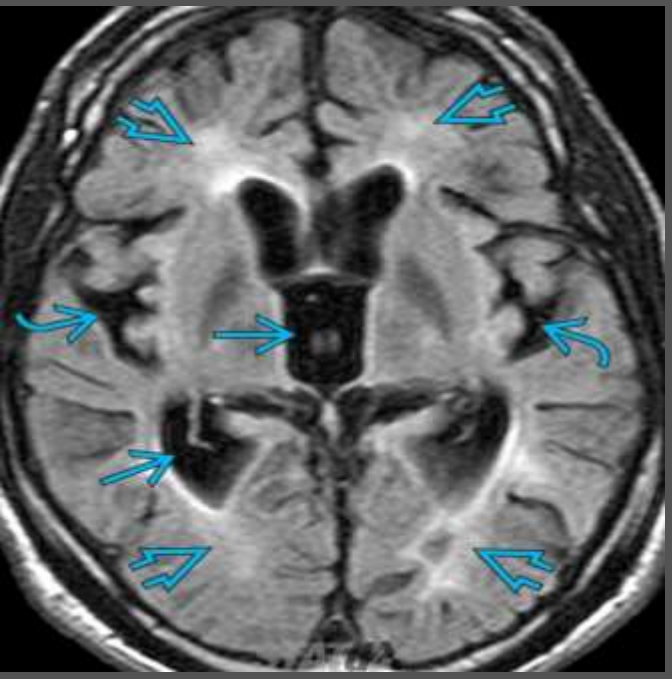


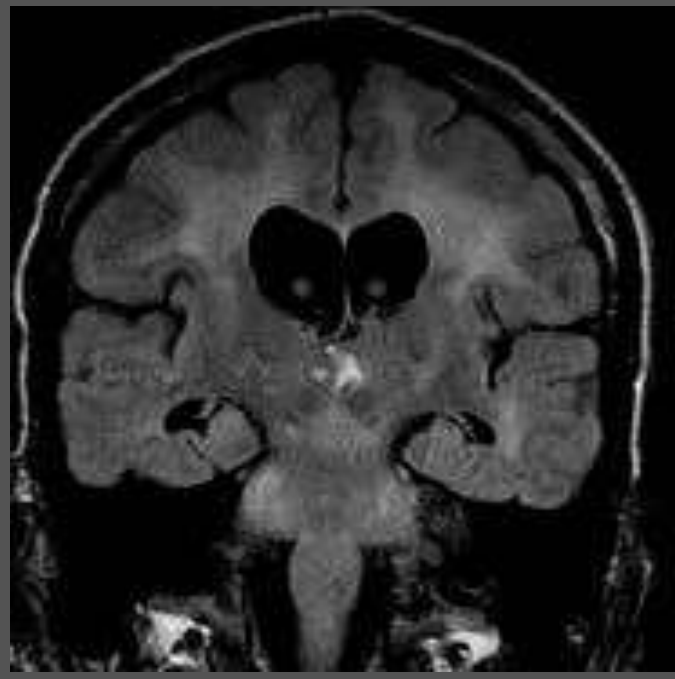


WHITE MATTER - ENCEPHALITIS

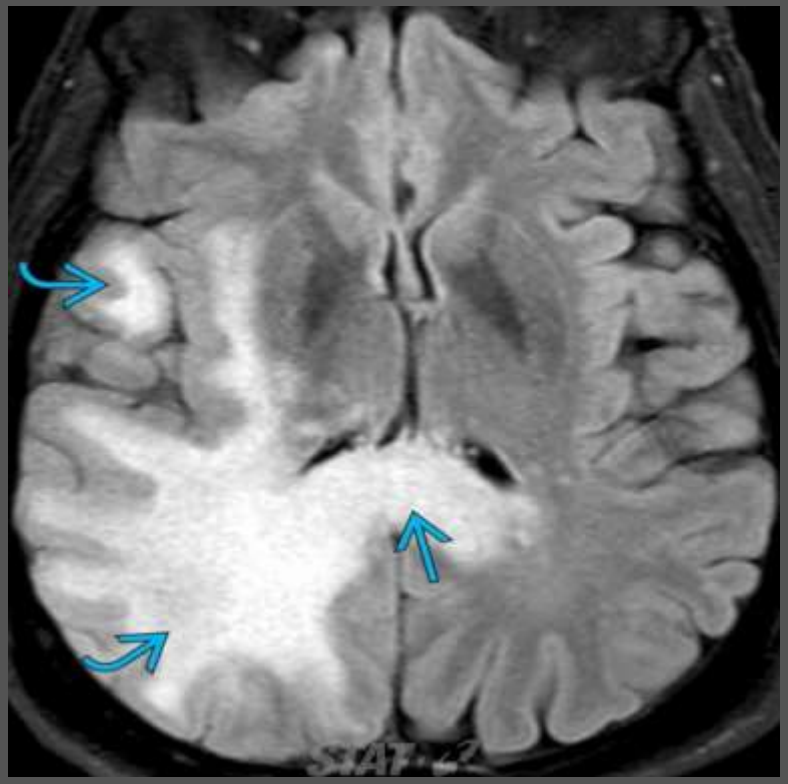


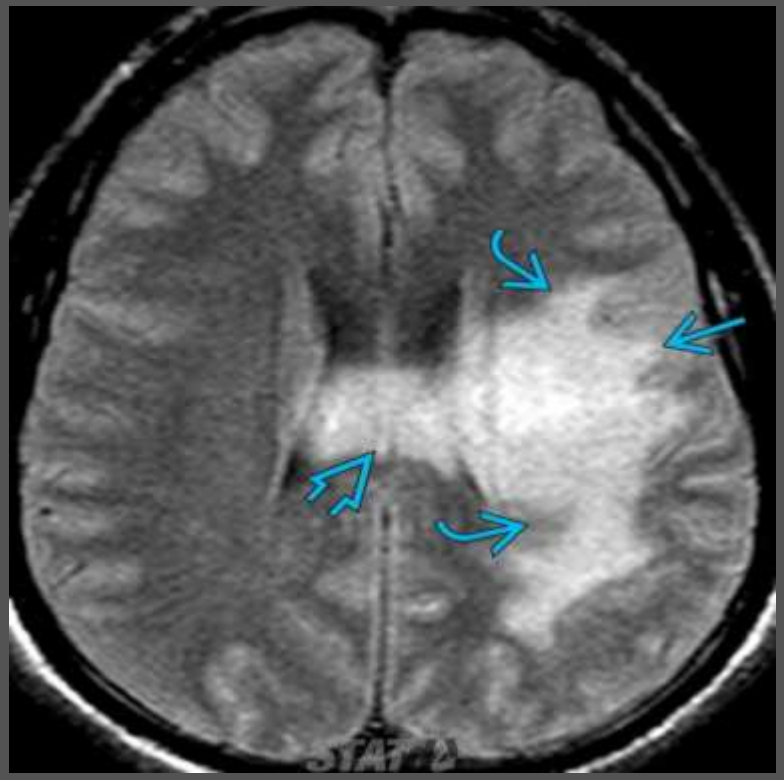
HIV LEUKOENCEPHALOPATHY





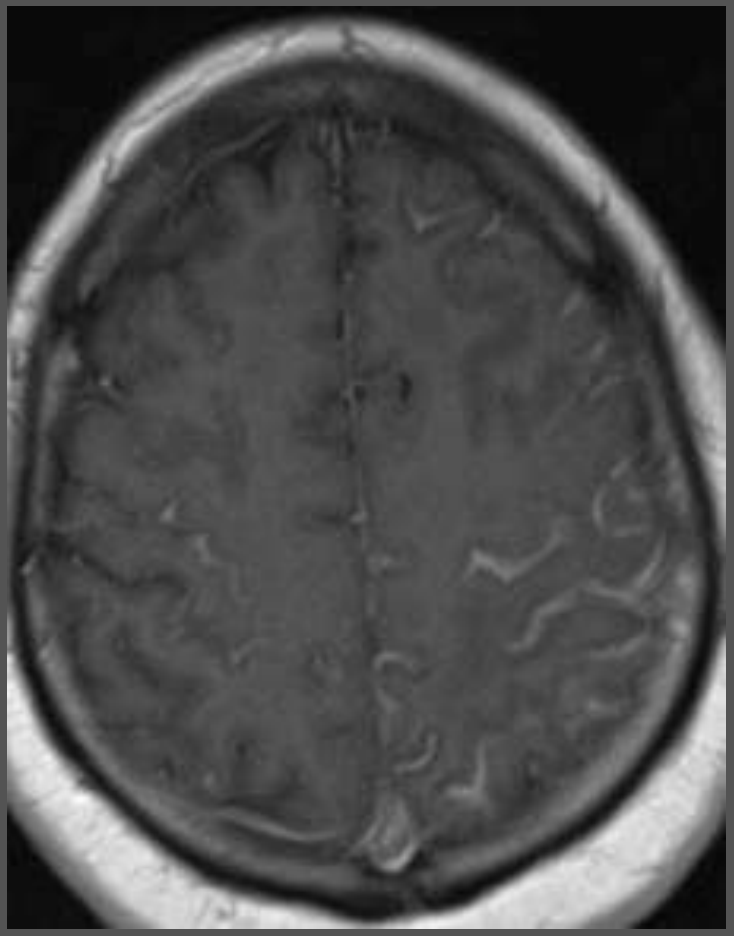
PROGRESSIVE MULTIFOCAL LEUKOENCEPHALOPATHY



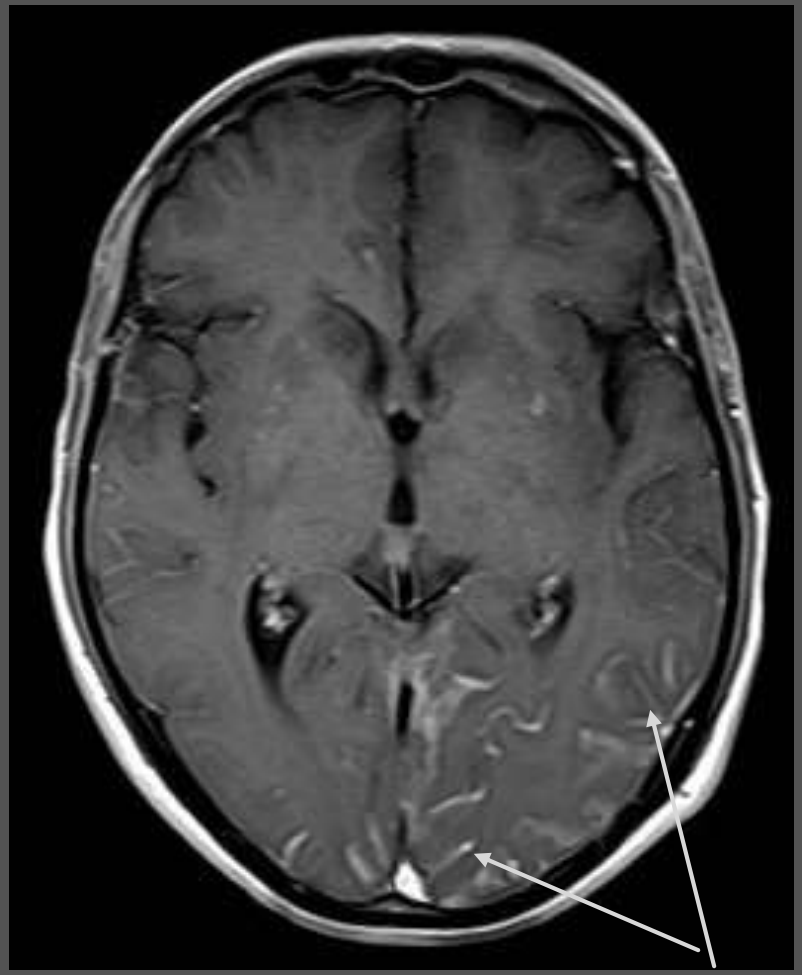


IMAGING IN MENINGITIS

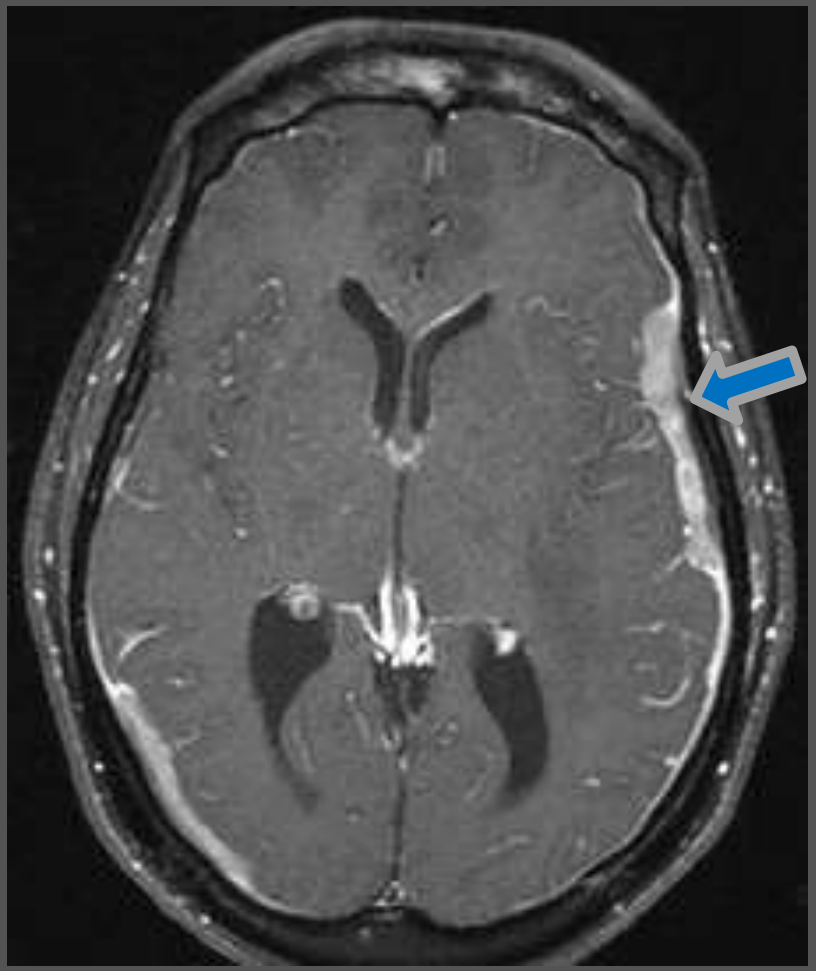
- 85% of acute bacterial meningitis: Pneumococcus or Streptococcus
- lumbar puncture and urgent initiation of antibiotic therapy, without prior imaging



MENINGEAL ENHANCEMENT

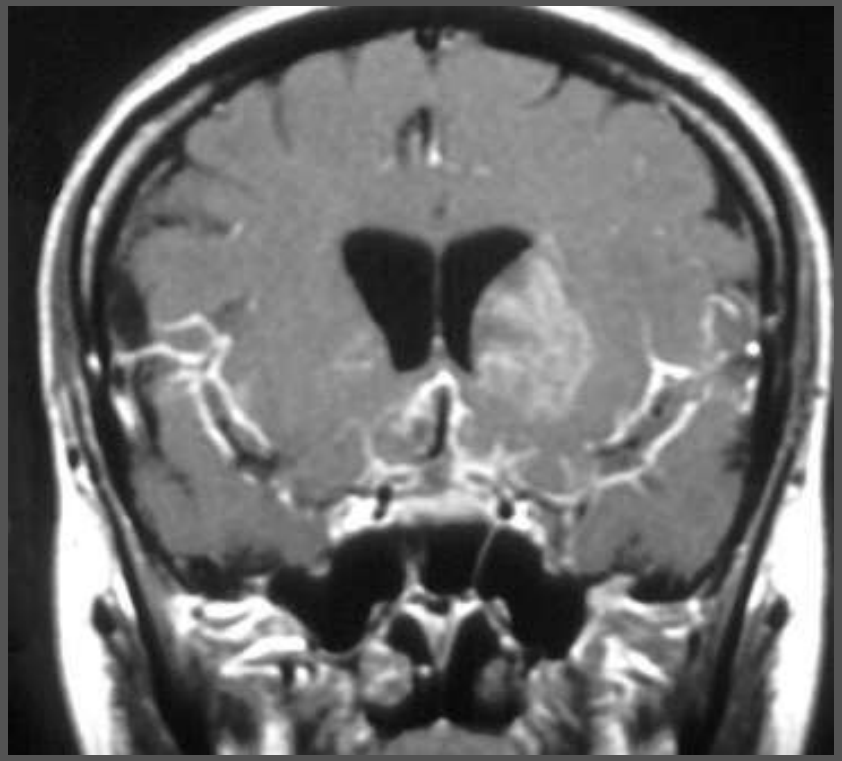


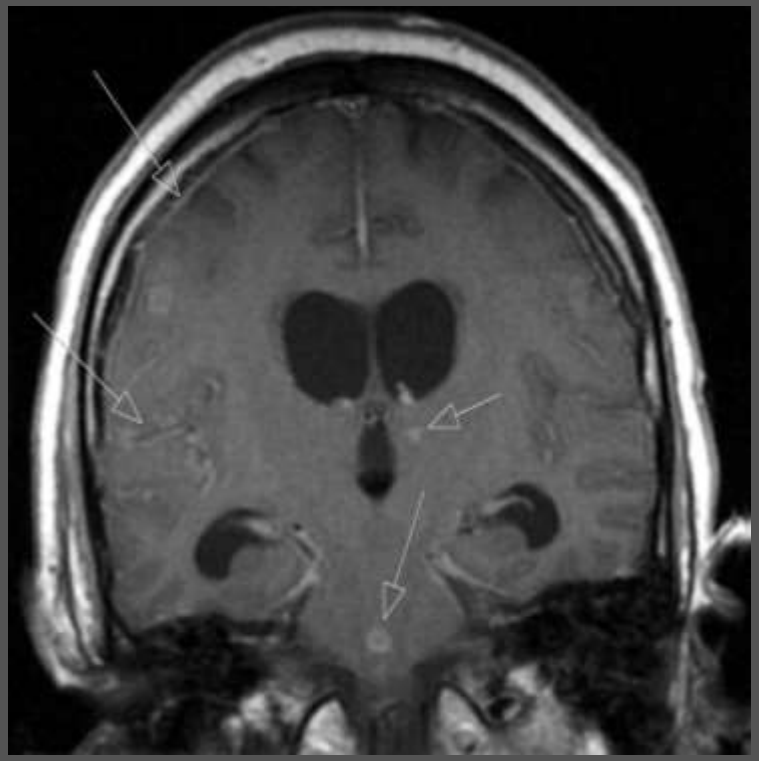
LEPTOMENINGEAL



PACHYMENINGEAL

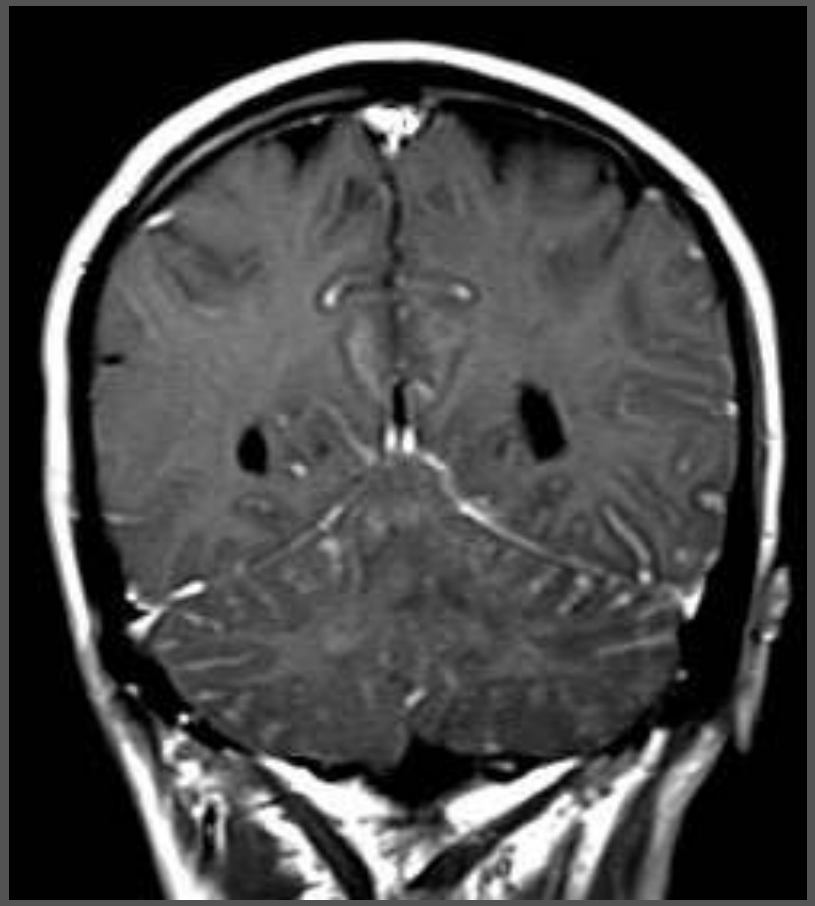
TB MENINGITIS

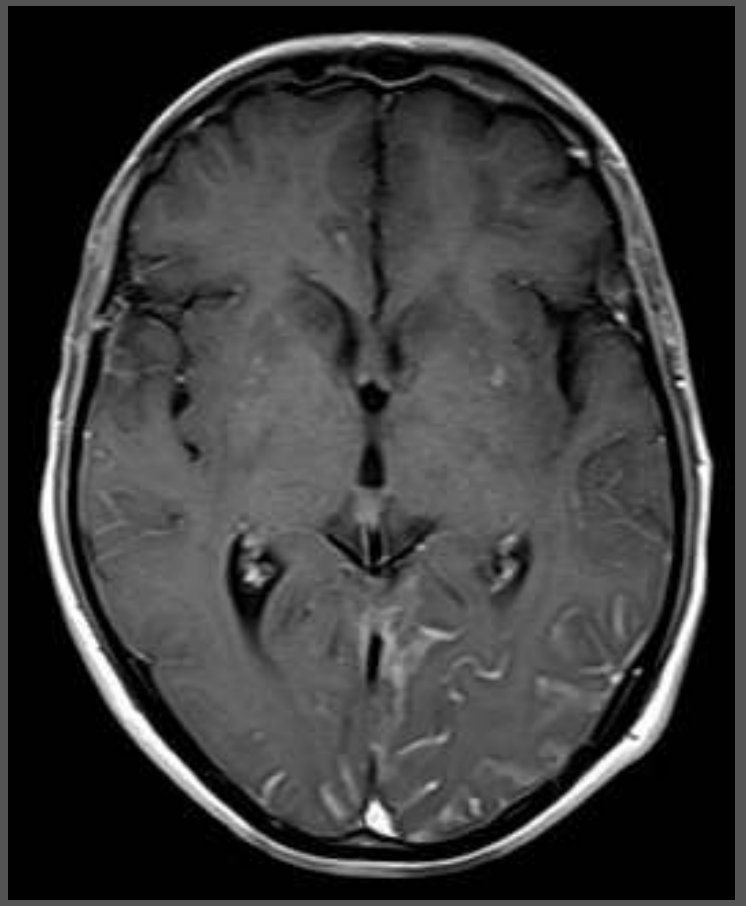




Post-contrast T1-weighted

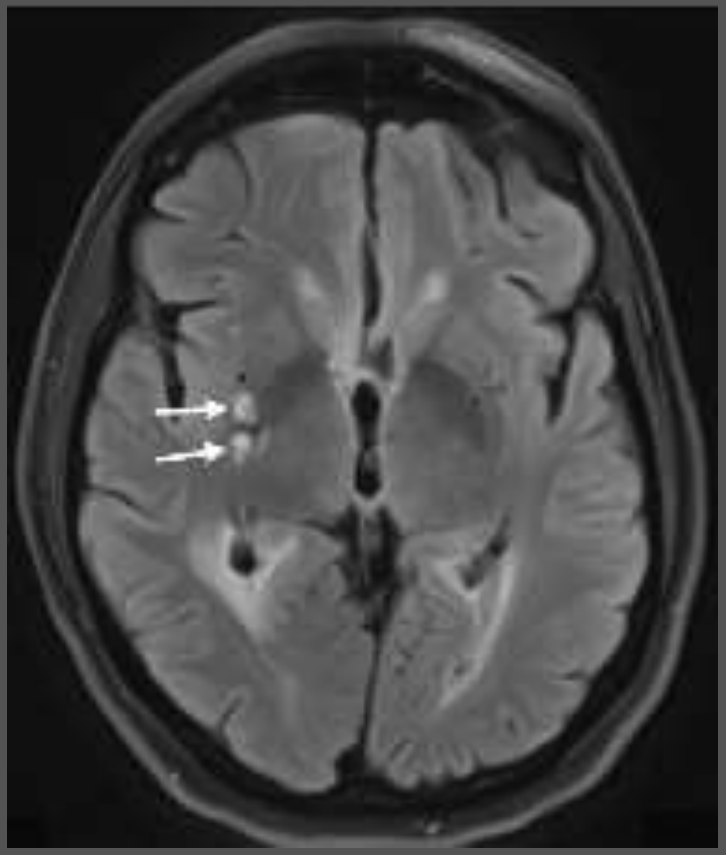
CRYPTOCOCCAL MENINGITIS

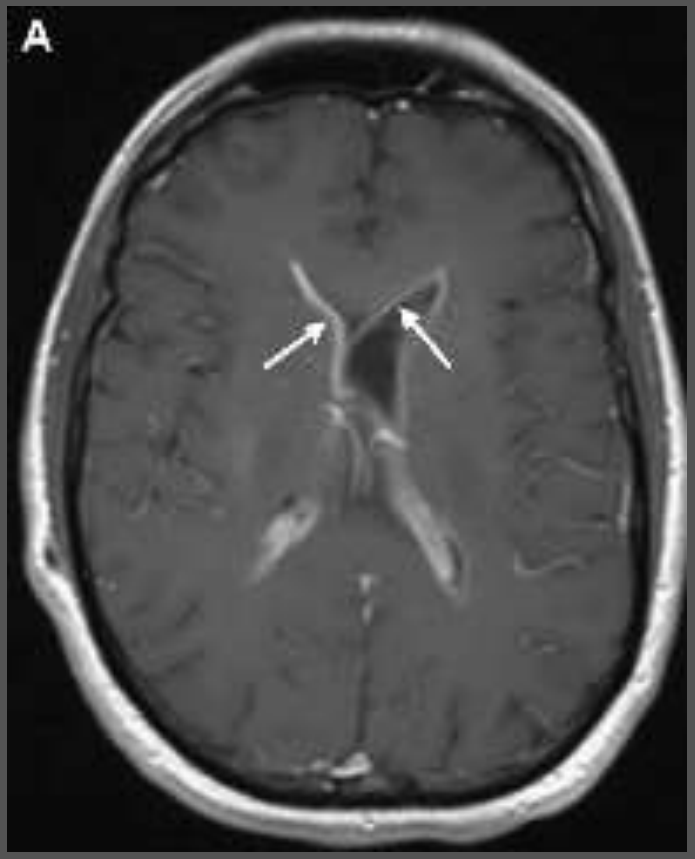




Post-contrast T1-weighted

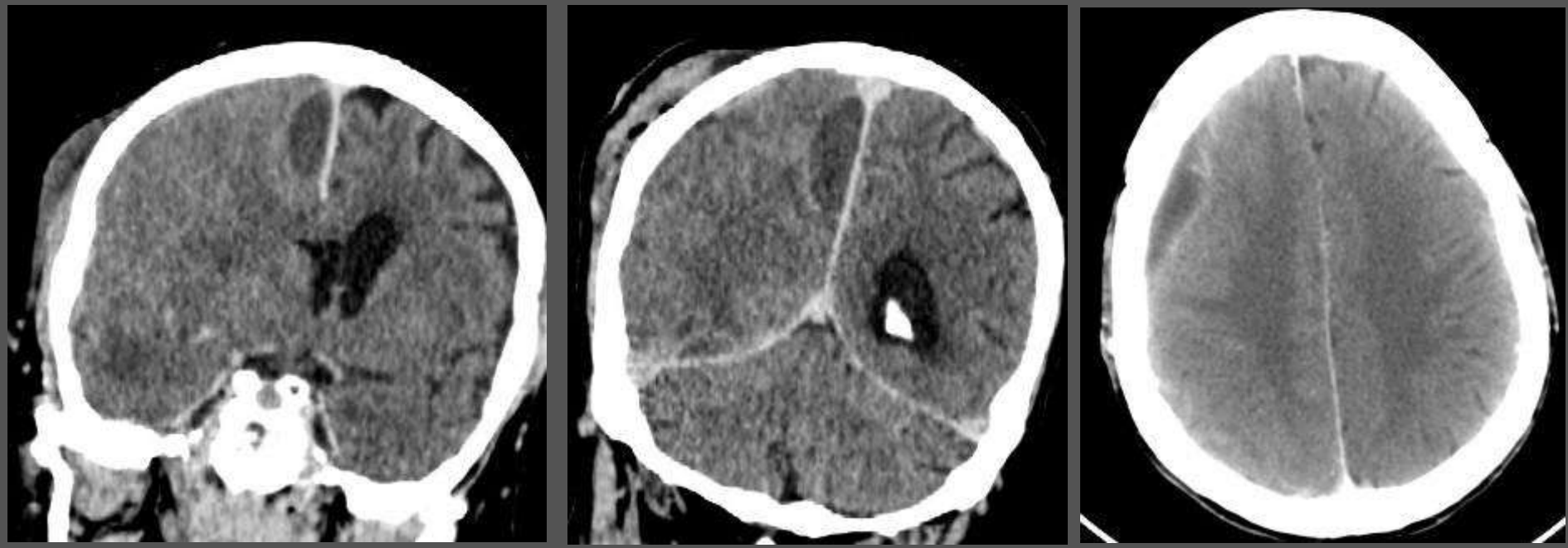
VENTRICULITIS



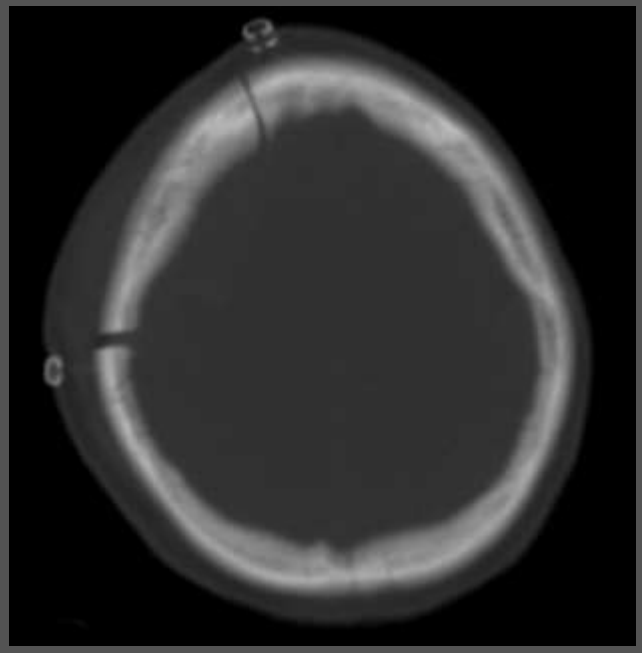


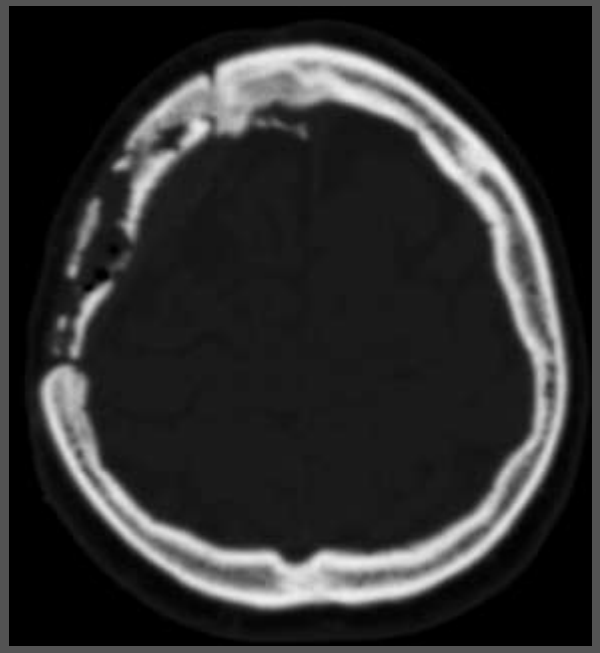
CRYPTOCOCCUS : EPENDYMAL ENHANCEMENT

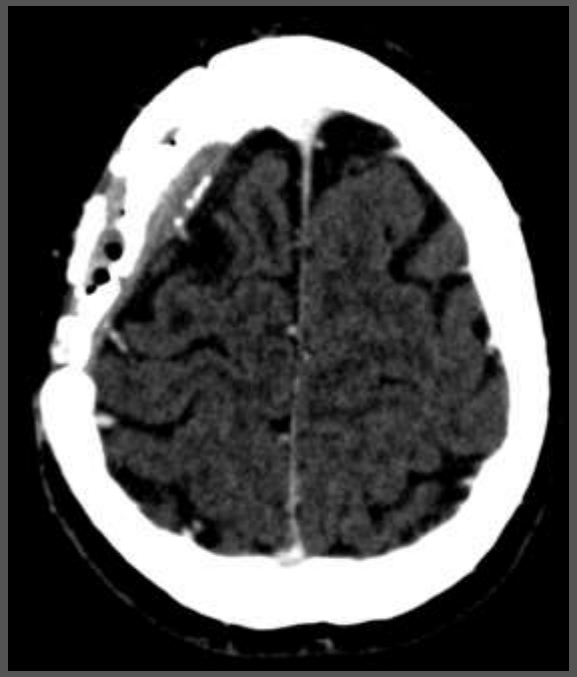
SUBDURAL EMPYEMA



OSTEOMYELITIS







CNS INFECTIONS: APPROACH

CT

MR T1W, T2W
FLAIR ; STIR
neuroparenchymal features
meningeal processes
extra-axial collections

Gd-enhanced

DWI
cerebritis, abscess , empyema, ventriculitis
ischaemic complications

MR Spectroscopy
metabolic signatures

THANK YOU

ANY QUESTIONS?

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