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Trauma & Emergency Radiology

Intracranial infections

Tormund H. Njølstad

Department of Radiology

Haukeland University Hospital, Bergen, Norway

Haukeland University Hospital

Conflict of interests

- No conflict of interests related to the contents of this presentation

Indication for imaging

Diagnose meningitis and etiology → LP

Rule out meningitis → LP

NPV of meningeal abnormalities to diagnose meningitis

- CE-3D T1 GRE: 80% *Jeevandham BJR 2017*
- CE-3D FLAIR: 95%
- CE-3D T1 SE: up to 100% *Sommer Eur Radiol 2020*

Contraindications to LP → CT/MRI

Imaging (CT) before LP?

CT før spinalpunksjon? Sjelden indisert og skal aldri forsinke oppstart av antibiotika som gis umiddelbart ved mistanke om bakteriell meningitt, men CT bør utføres i de tilfeller hvor en mistenker abscess, hydrocefalus, intracerebral blødning eller infarkt.
Indikasjon for CT før spinalpunksjon ved:

- Raskt innsettende bevissthetsendring (raskt fall i GCS)
- Tilkommet fokal neurologi
- Nyoppståtte generaliserte kramper.
- Vurderes også ved immunsvikt (kan ha mindre symptomer på intracerebrale abscesser)

- **Usually not required**
- **Should never delay treatment**

Indications for CT:

- **Rapid decline in GCS**
- **New-onset focal neurological deficit**
- **New-onset generalized seizures**
- **Immunocompromised**

https://metodebok.no/

Imaging strategy

Choice of imaging modality

CT

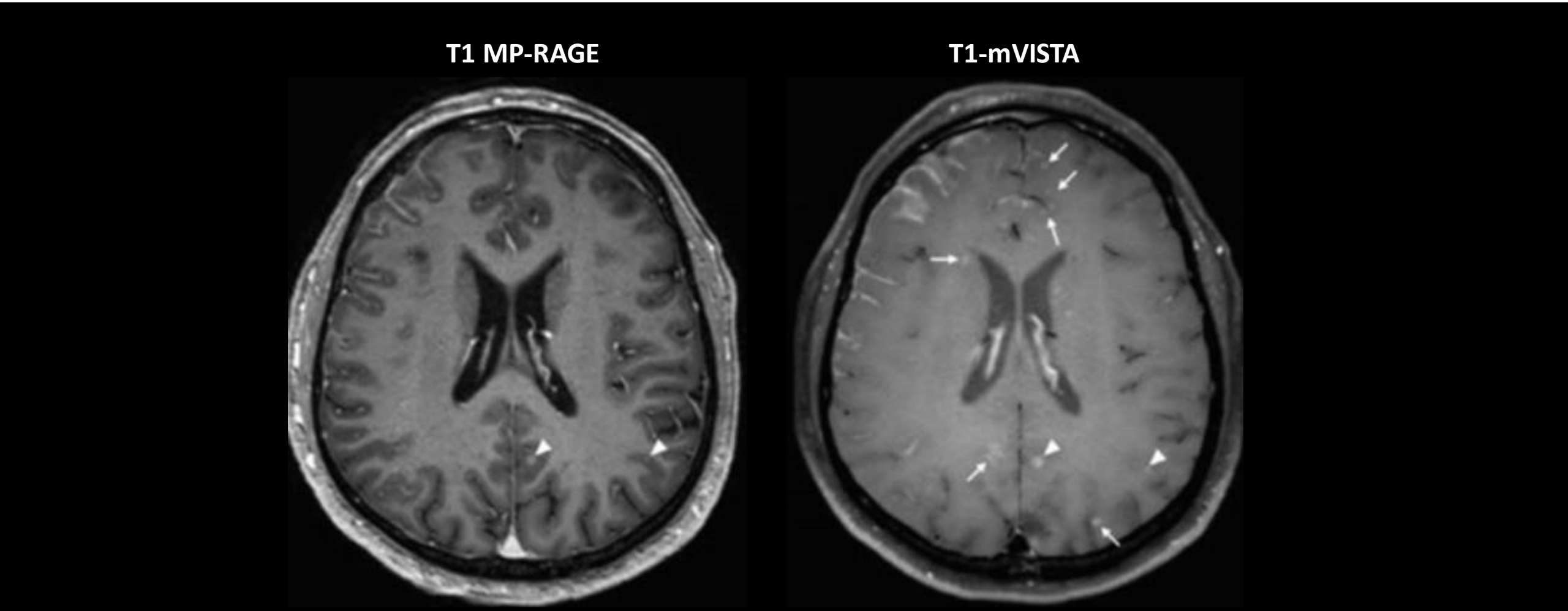
- Rapid
- Available
- Well tolerated (critically ill)
- Can exclude other life threatening conditions

- + contrast depending on availability of MR

MR

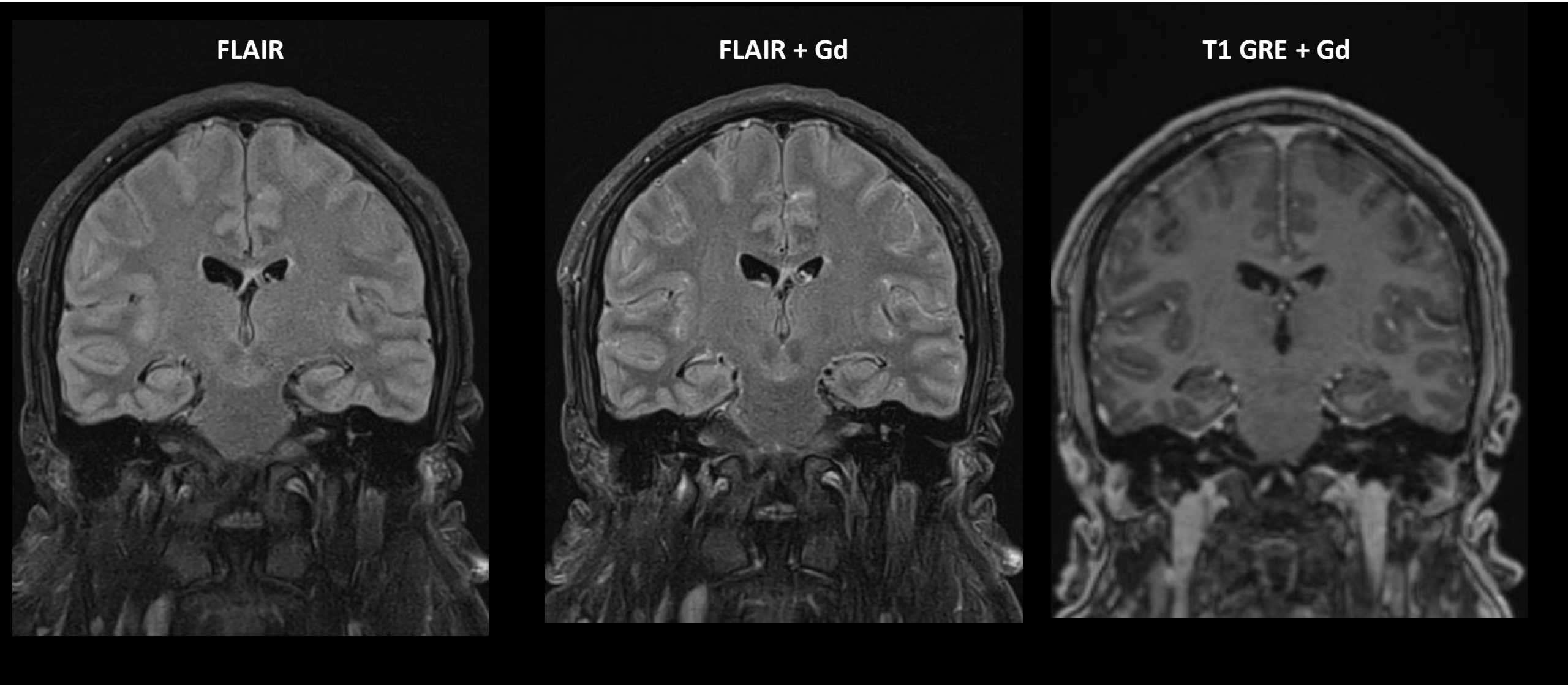
- More sensitive for detecting signs of CNS infection (subtle findings) and complications

3DT1 + Gd: TSE black blood > GRE

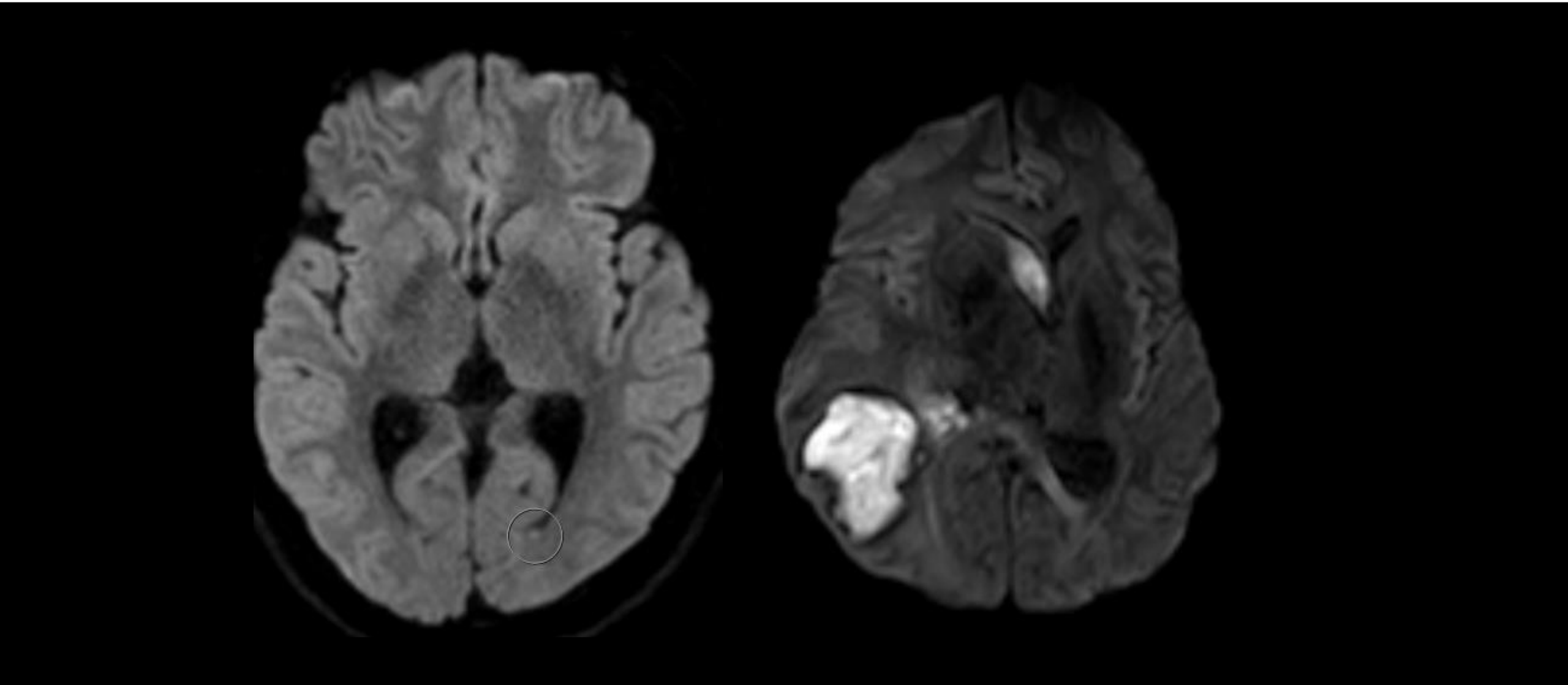


Sommer et al. Contrast-enhanced modified 3D T1-weighted TSE black-blood imaging can improve detection of infectious and neoplastic meningitis. Eur Radiol 30, 866–876 (2020)

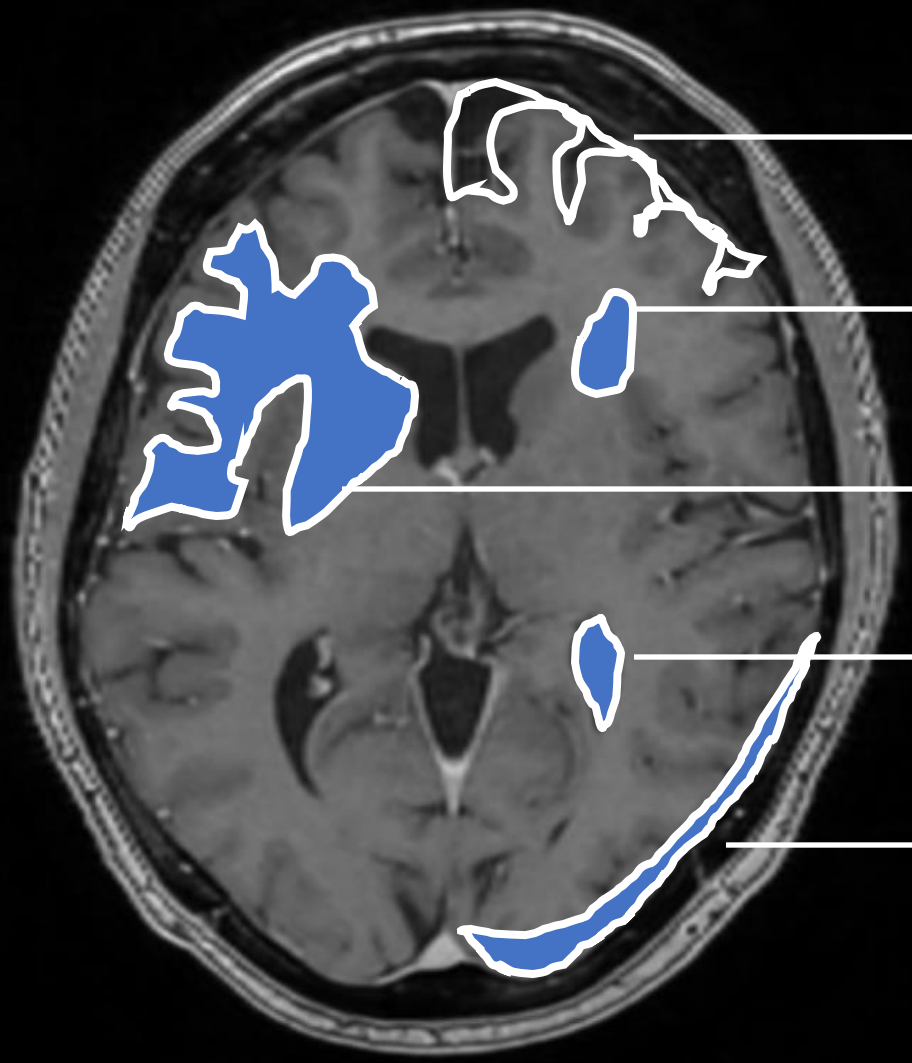
3D FLAIR + Gd > T1 GRE + Gd



DWI



Imaging findings



Meningitis

Cerebritis / brain abscess

Encephalitis

Ventriculitis

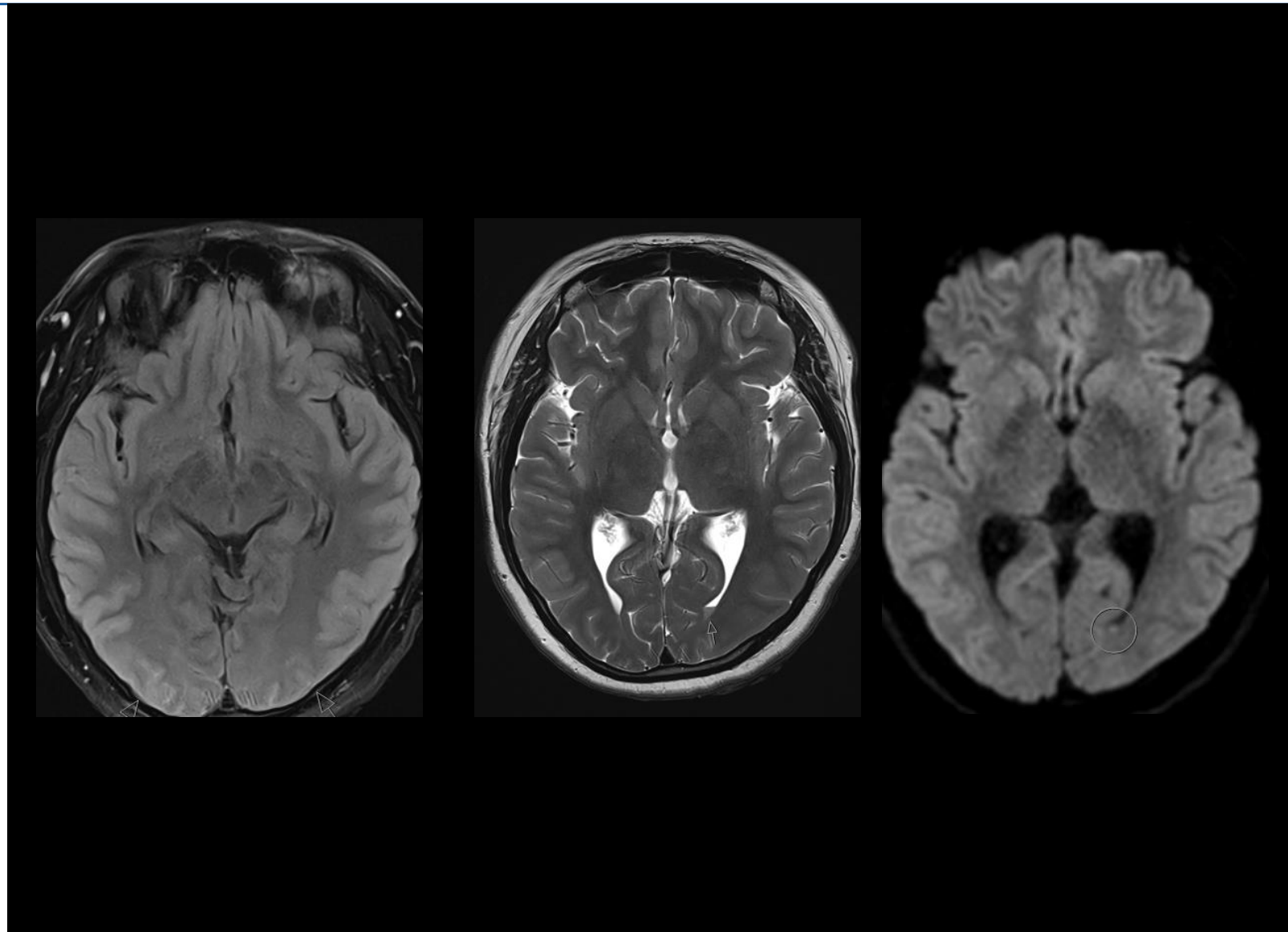
Subdural empyema and epidural abscess

Skull base and paranasal sinus infections

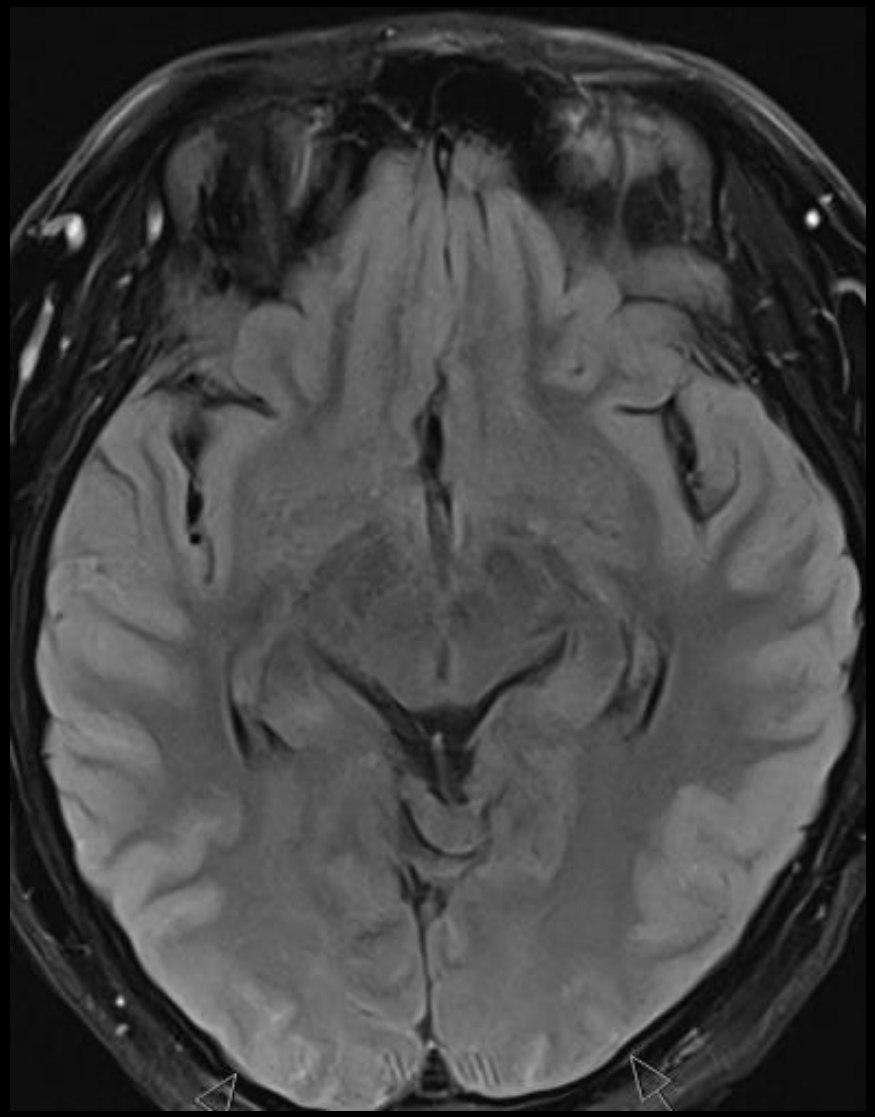
Meningitis and leptomeningeal infection

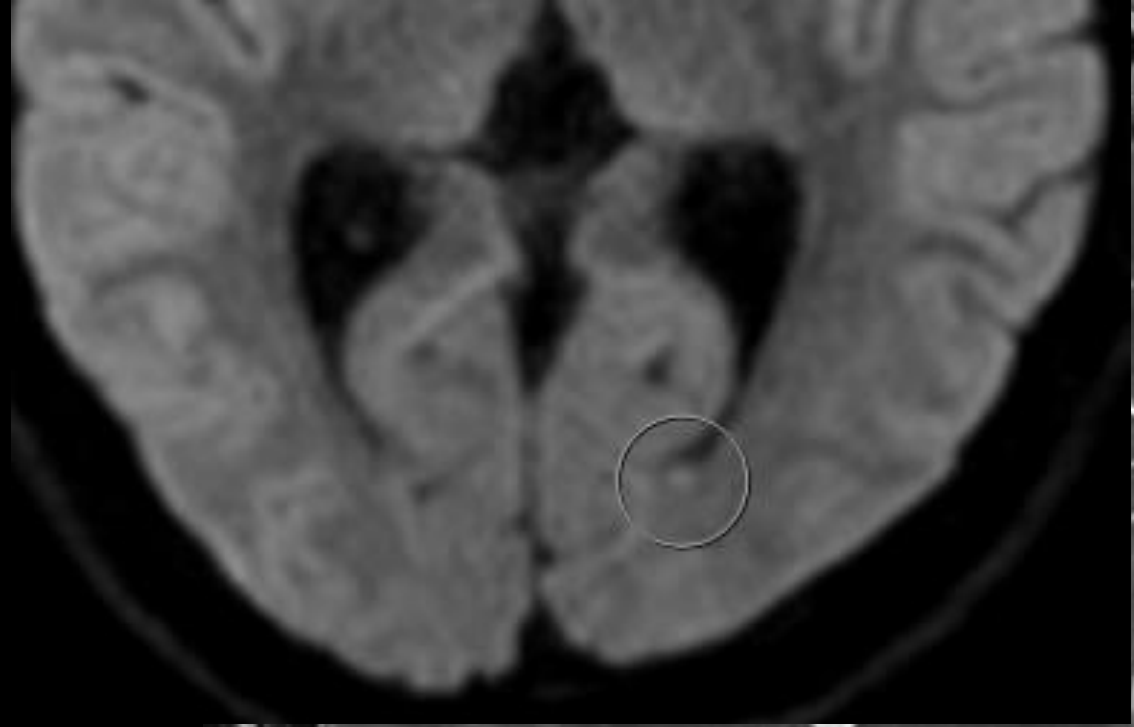
- **Imaging findings (often subtle!)**
  - FLAIR hyperintensity or diffusion restriction in subarachnoid space
  - Leptomeningeal enhancement (pia and arachnoid) – along sulci and cisterns
  - Pachymeningeal enhancement (dural) – less specific

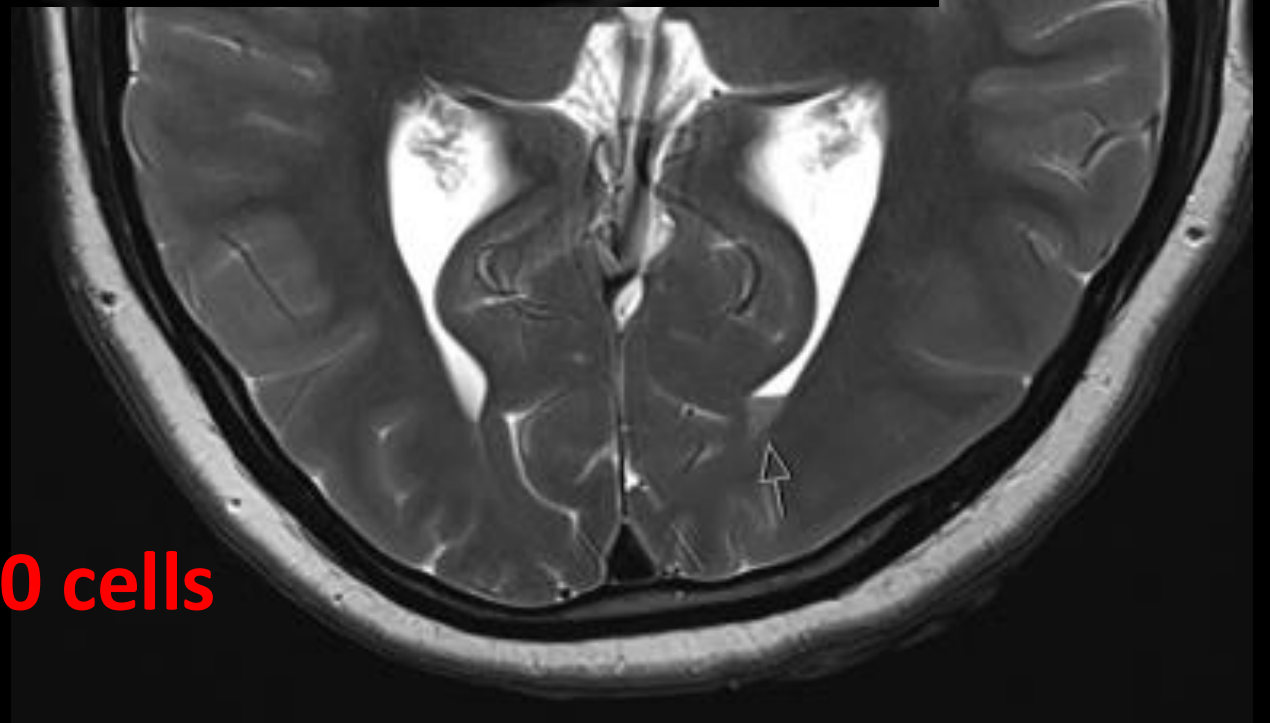
- **CSF diagnostic, imaging to exclude unexpected findings and evaluate complications**
  - Infarcts (vasculitis)
  - Hydrocephalus
  - Abscesses
  - Ventriculitis
  - Venous sinus thrombosis



Meningitis

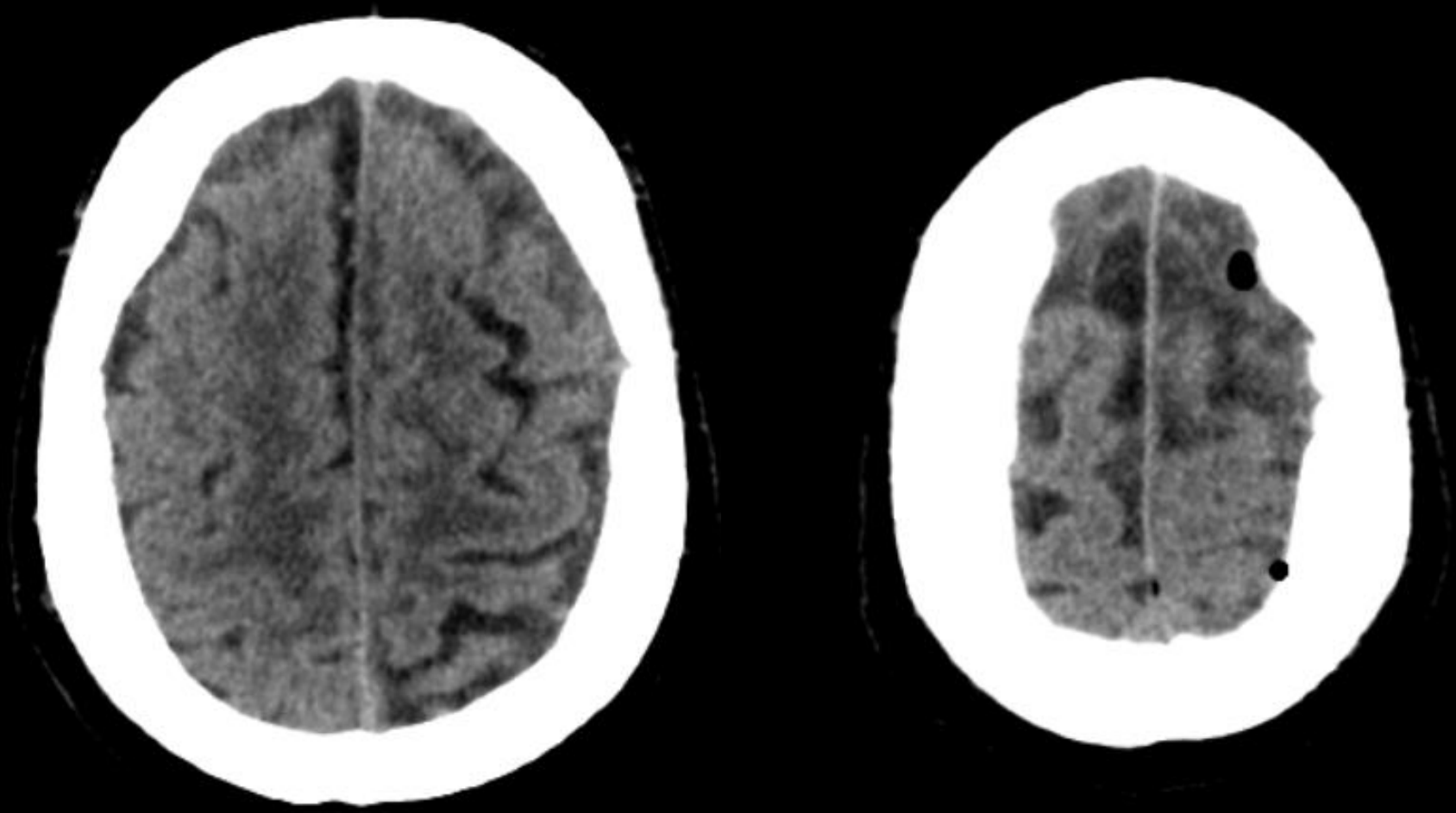






LP: >3000 cells

Meningitis (pneumococcal)



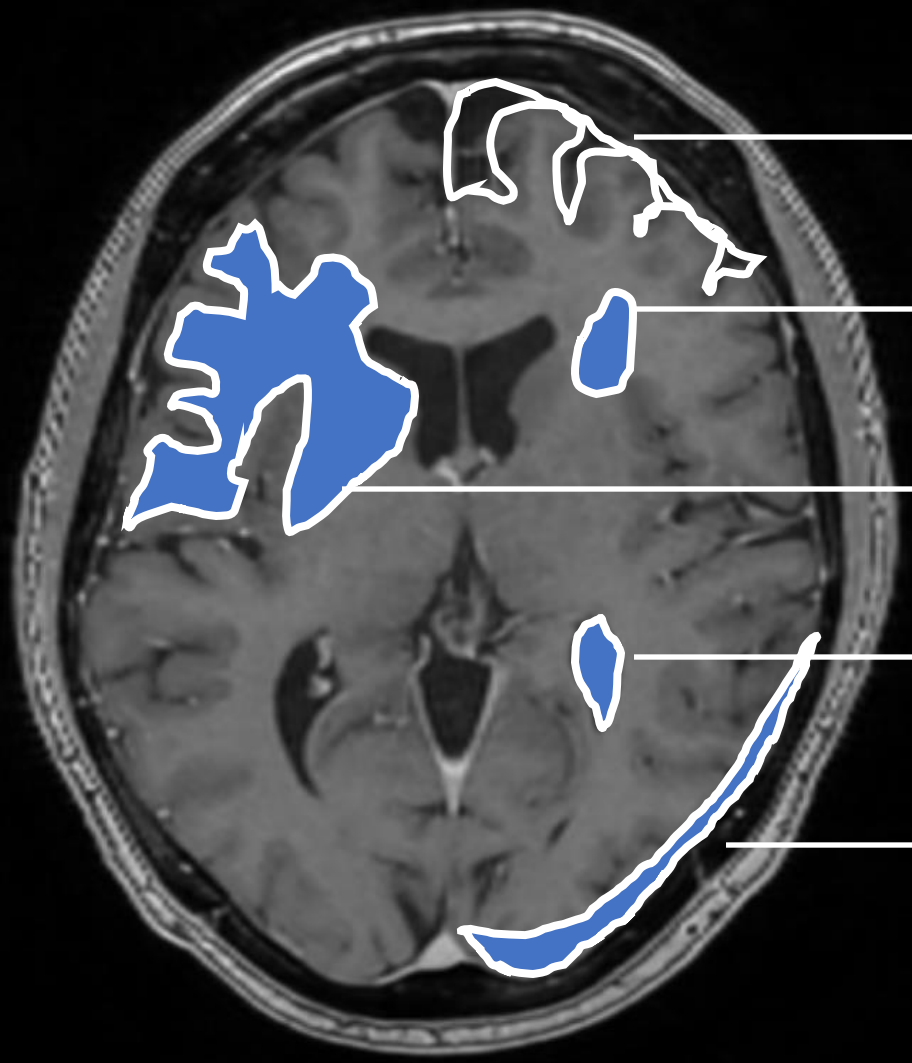
Conditions that produce pachymeningeal and leptomeningeal enhancement

Pachymeningeal	Leptomeningeal
• Intracranial hypotension	• Acute stroke
• Idiopathic	• Infection
• Infection	• Inflammatory diseases (eg, sarcoidosis)
• Inflammatory diseases (eg, sarcoidosis)	• Metastases
• Metastases	
• Shunting	
• SAH	

Mohan et al. Imaging of Meningitis and Ventriculitis, Neuroimag Clin N Am 22 (2012) 557–583

Differential diagnosis of sulcal hyperintensity on FLAIR images

- Meningitis
- SAH
- Leptomeningeal carcinomatosis
- Leptomeningeal melanosis
- Fat-containing tumors
- Acute stroke
- Moyamoya disease
- Increased blood pool/CSF ratio
- Contrast media
- Supplemental oxygen
- CSF pulsation
- Vascular pulsation
- Magnetic susceptibility artifact
- Motion artifact



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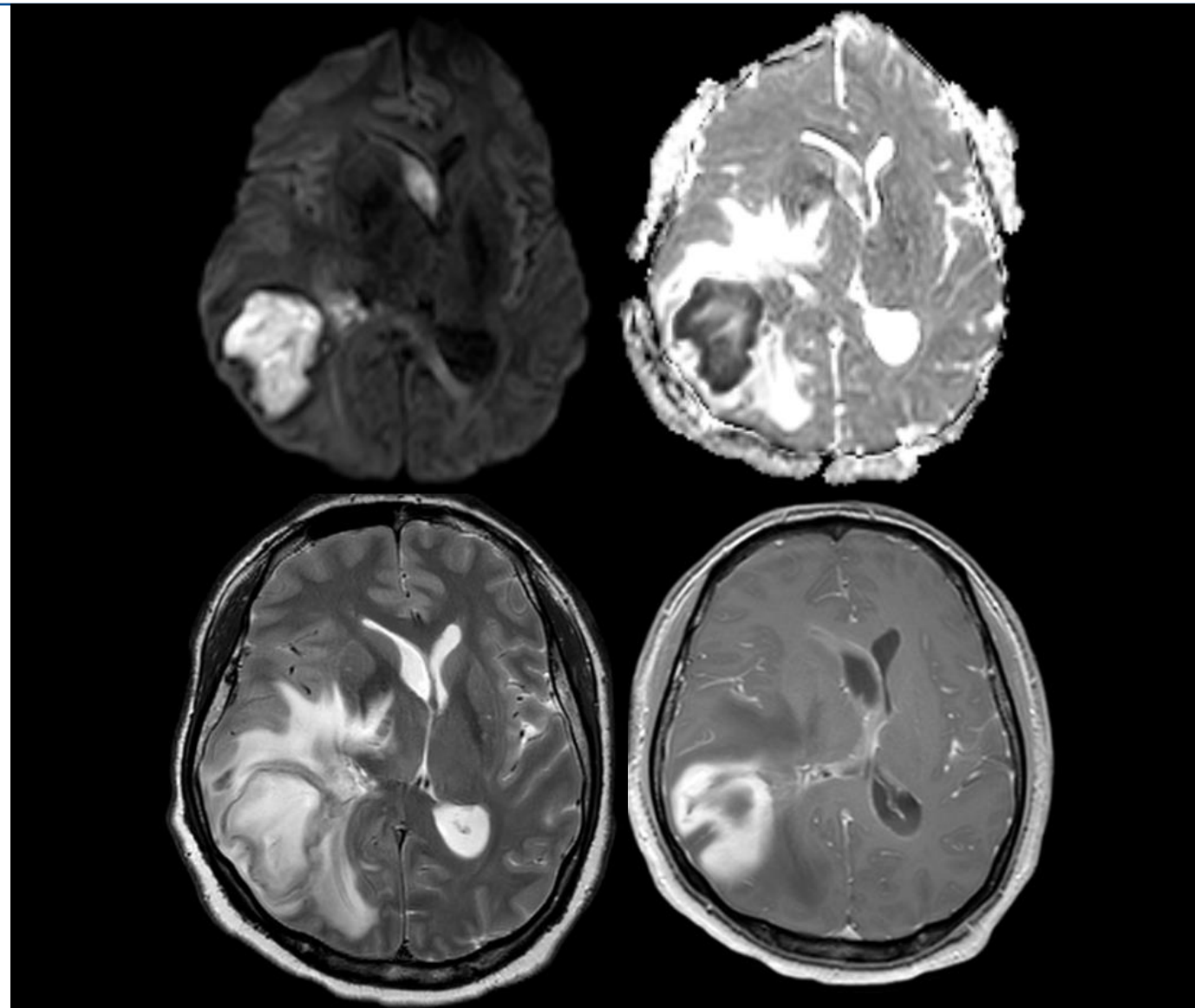
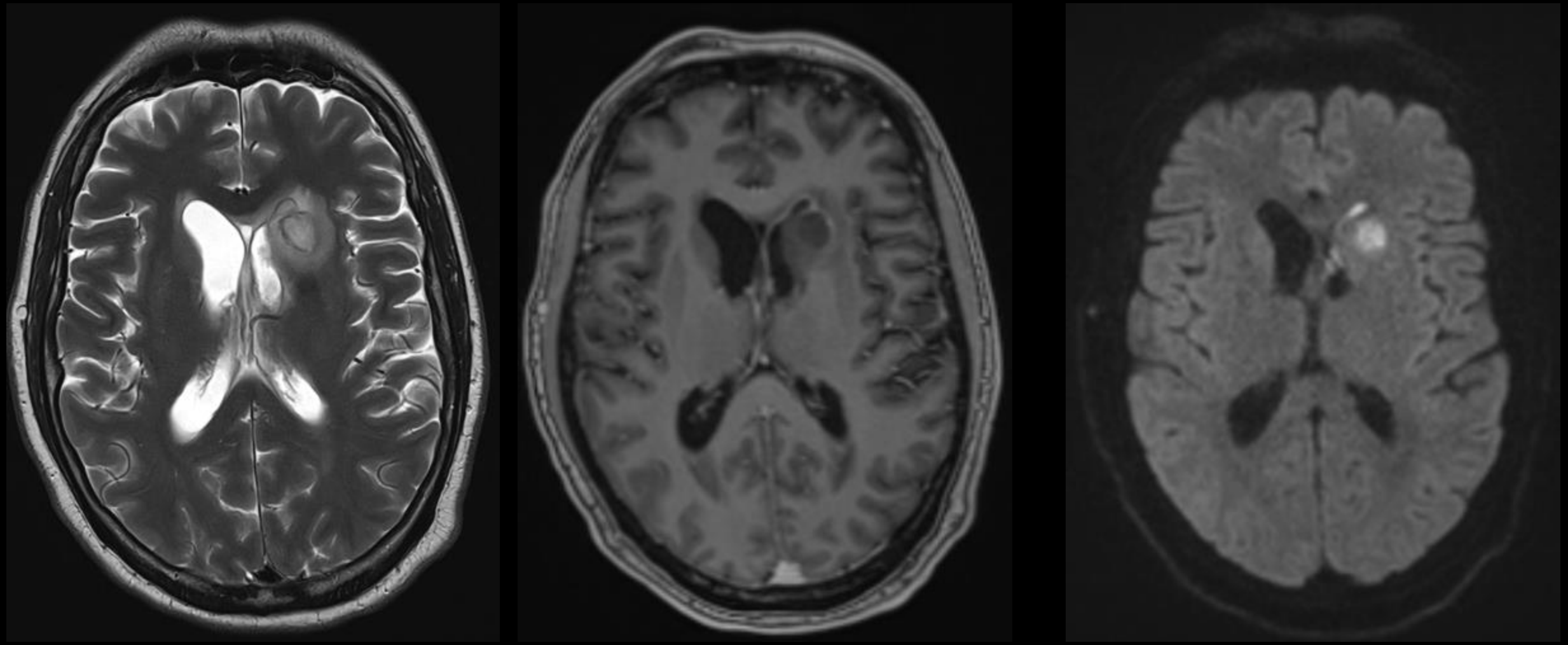
Skull base and paranasal sinus infections

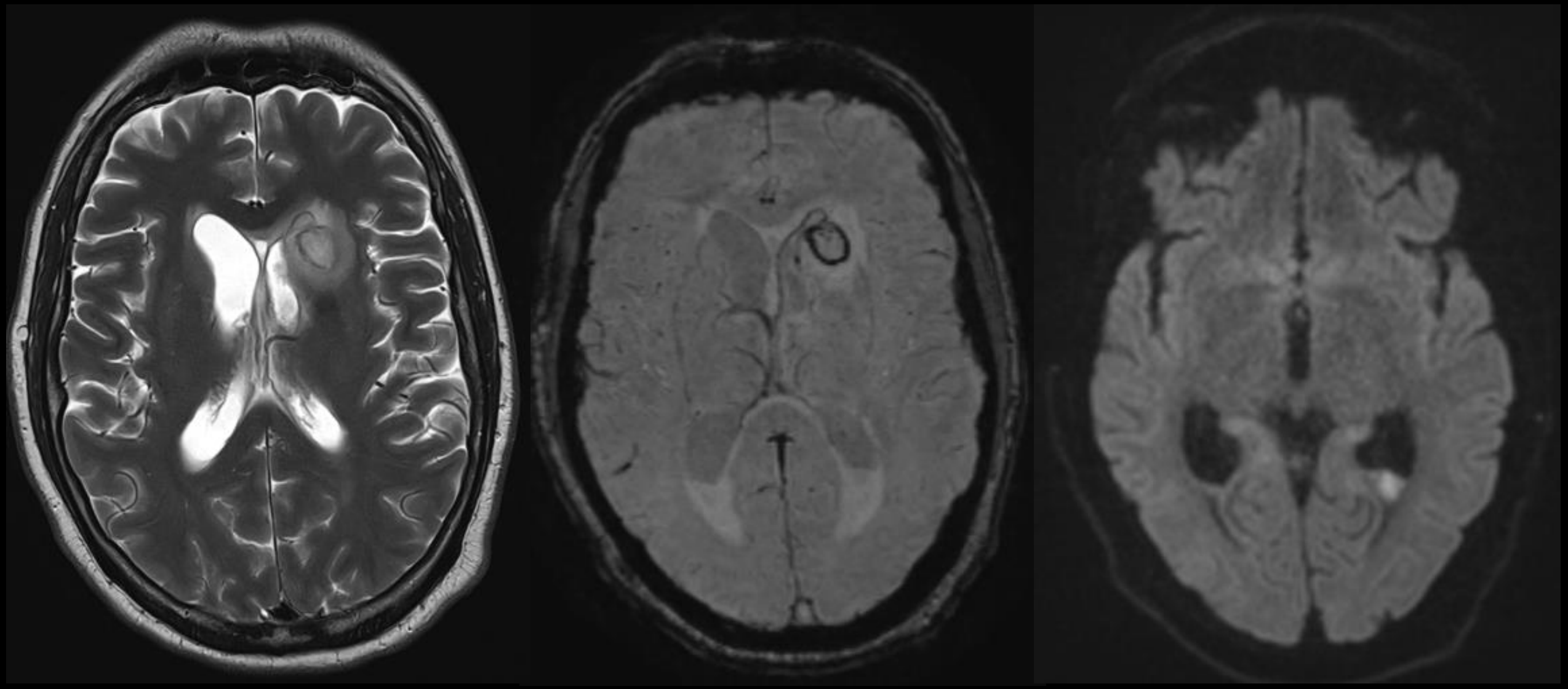
Cerebritis and brain abscess

- **Imaging findings** – early cerebritis / late cerebritis – early capsule / late capsule
  - Peripheral contrast enhancement
  - Restricted diffusion in pyogenic abscess core
    - Key distinguishing feature from necrotic tumor or cyst
  - ”Dual-rim sign” on SWI/GRE

- **Complications**
  - Infarcts (vasculitis)
  - Ventriculitis
  - Hydrocephalus
  - Venous sinus thrombosis

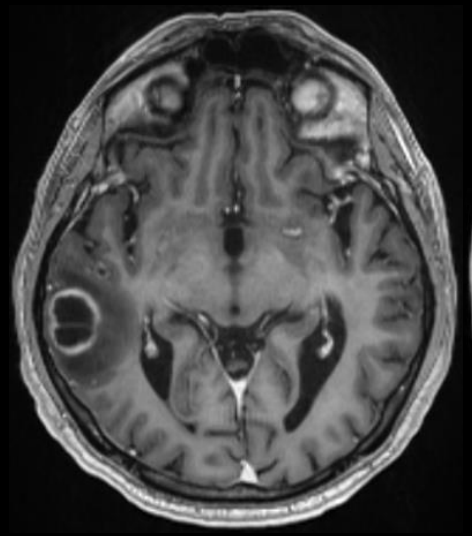
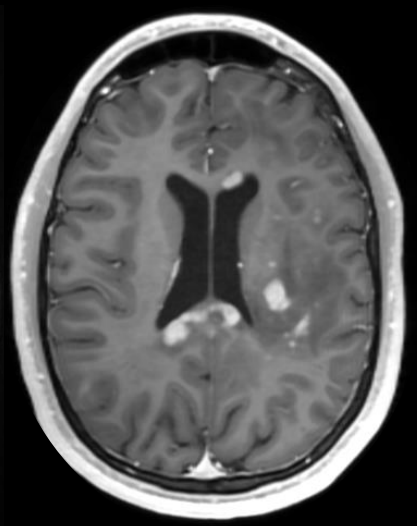
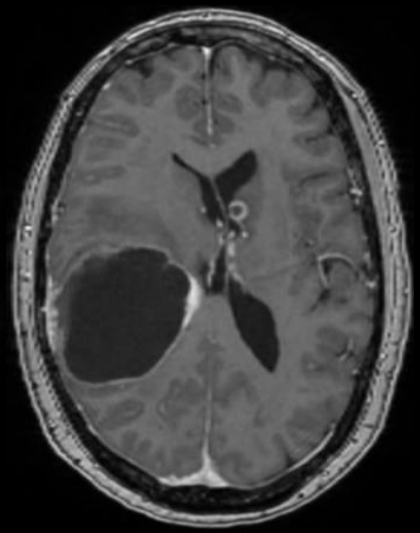
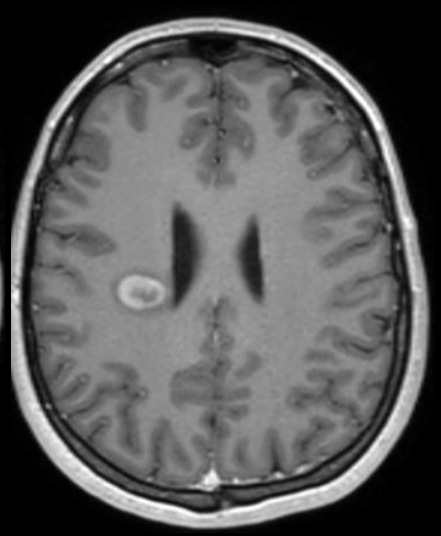
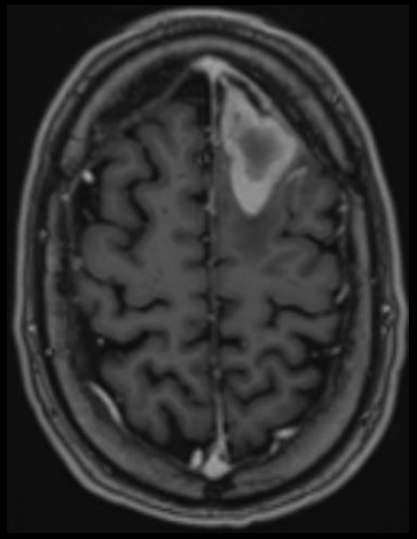
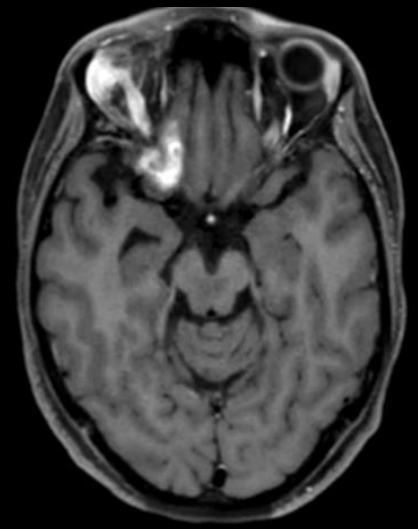


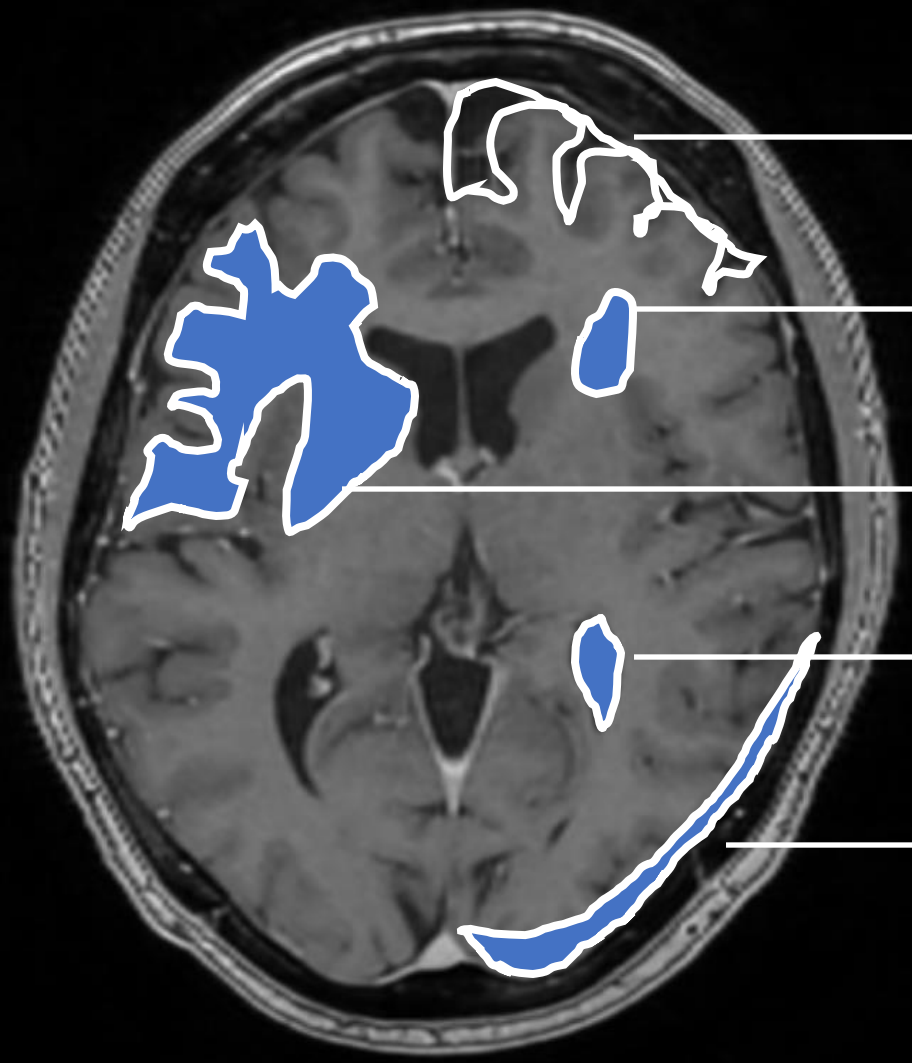




Correlate with history and clinics ++

Differentials for ring-enhancing lesions:

Malignant			Inflammatory	Vascular	Other
					
Glioblastoma	Lymphoma (in immuno-compromised)	Metastasis	Demyelination	Chronic hematoma	Radiation necrosis



Meningitis

Cerebritis / brain abscess

Encephalitis

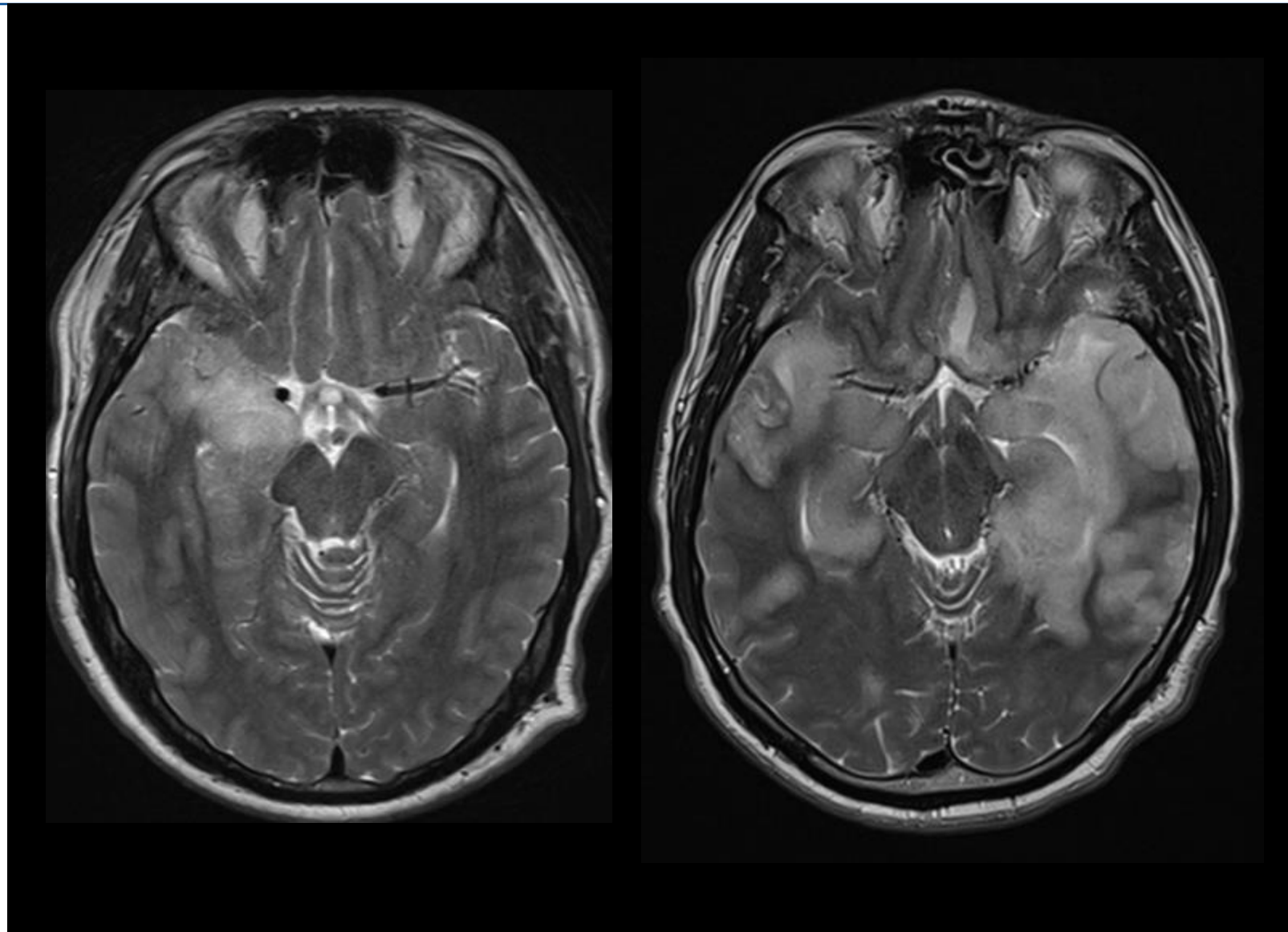
Ventriculitis

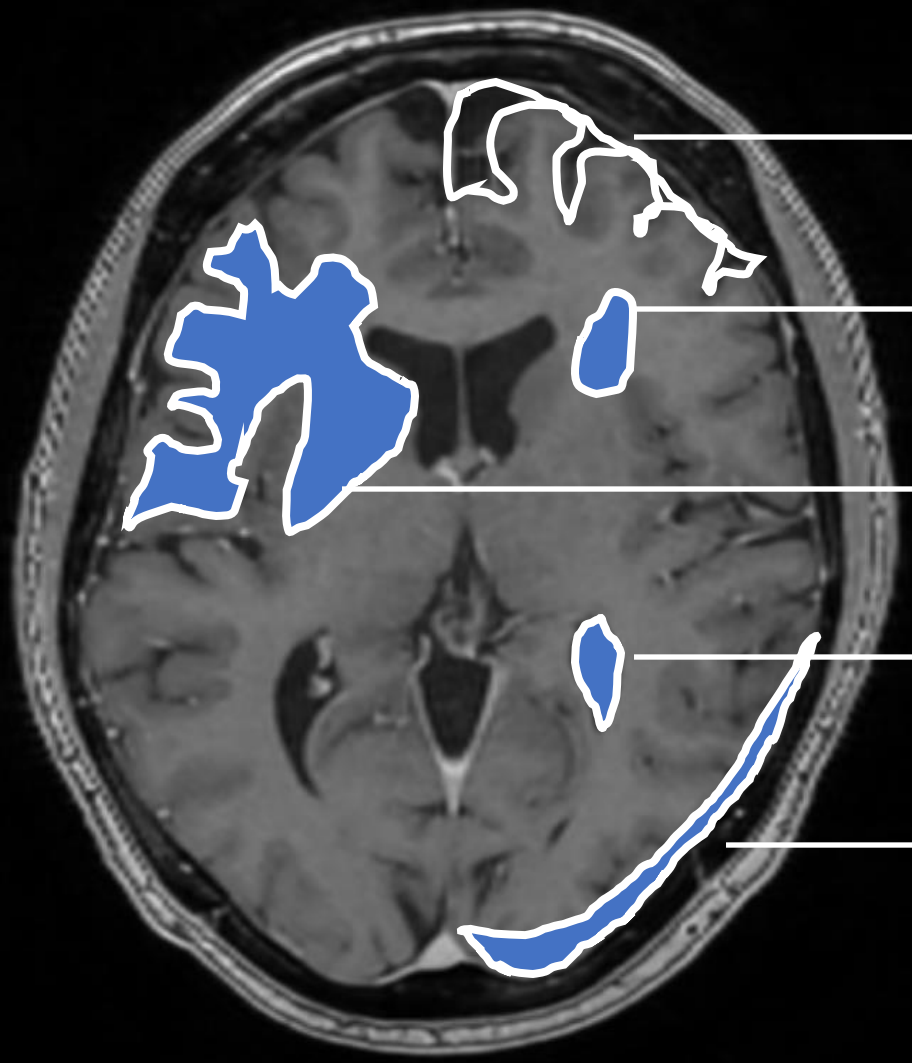
Subdural empyema and epidural abscess

Skull base and paranasal sinus infections

HSV encephalitis

- **Imaging findings**
  - Location: temporal lobes, insula, frontal lobe
  - CT: normal or low density +/- hemorrhage
  - MR: high T2/FLAIR, may restrict, may enhance, may show microhemorrhages
- **DDX:**
  - Ischemia
  - Neoplasm
  - Limbic / other viral encephalitis
  - ++





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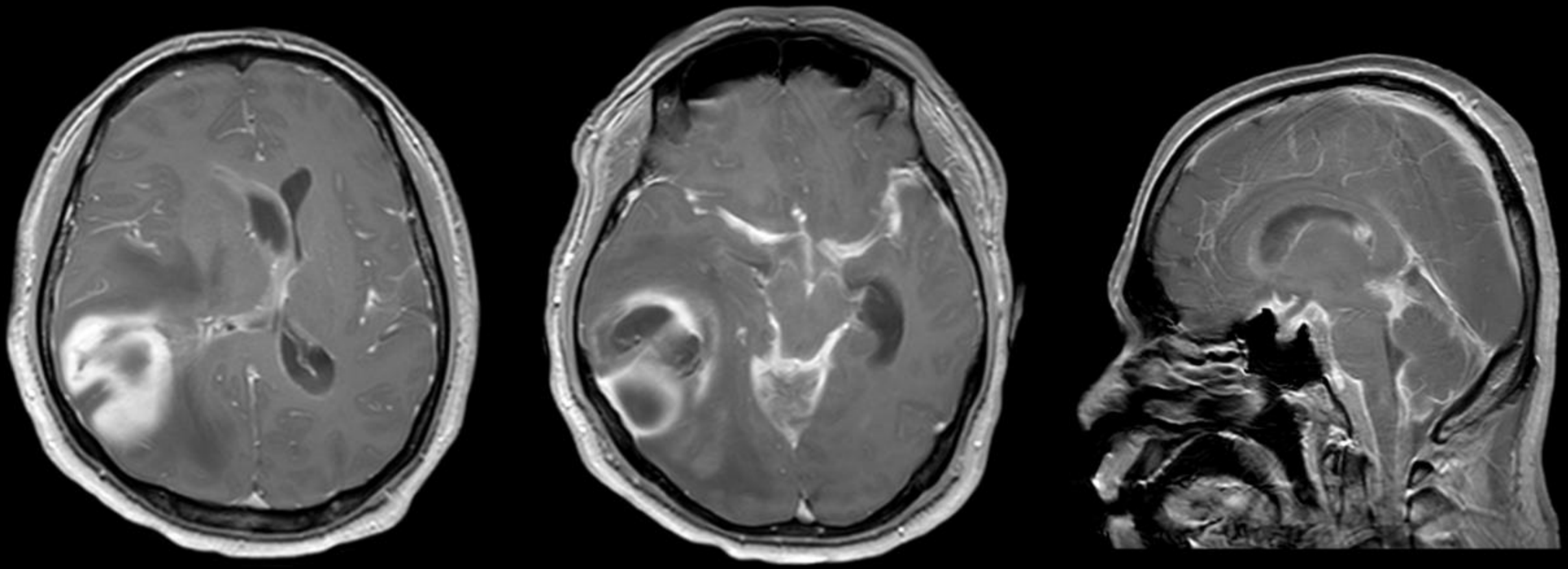

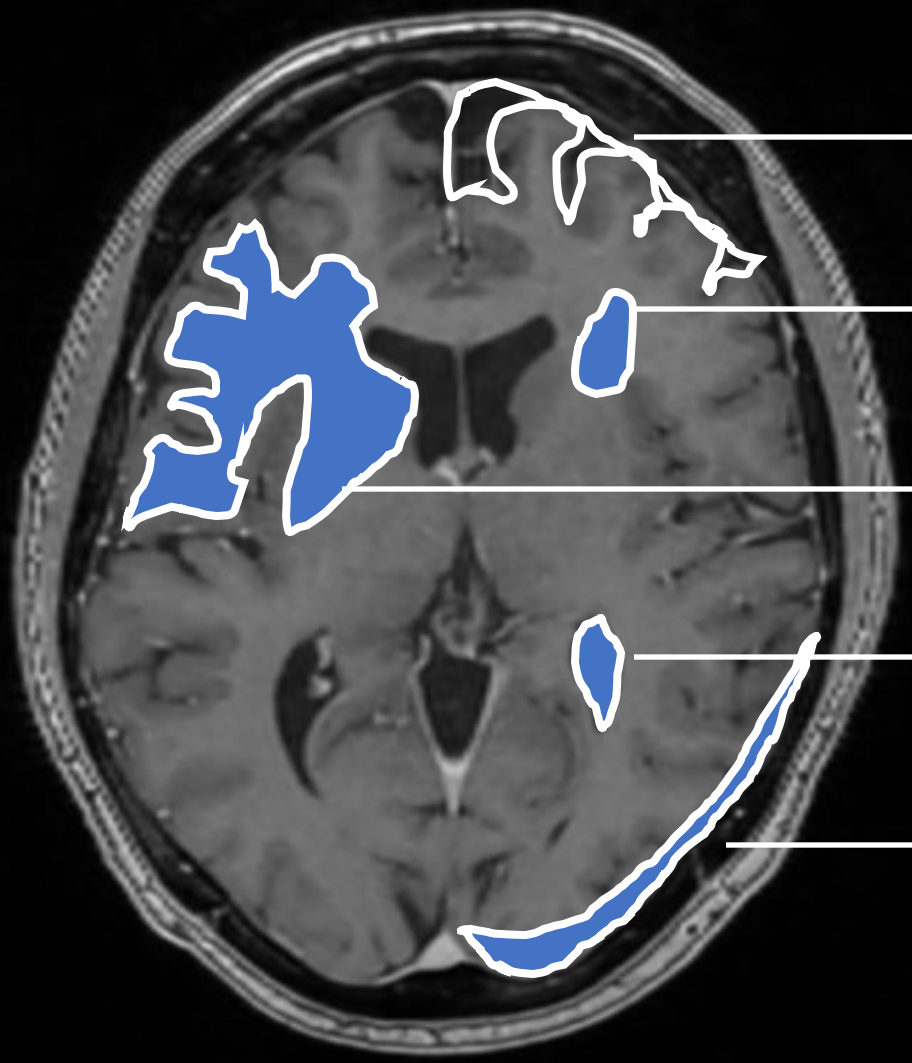

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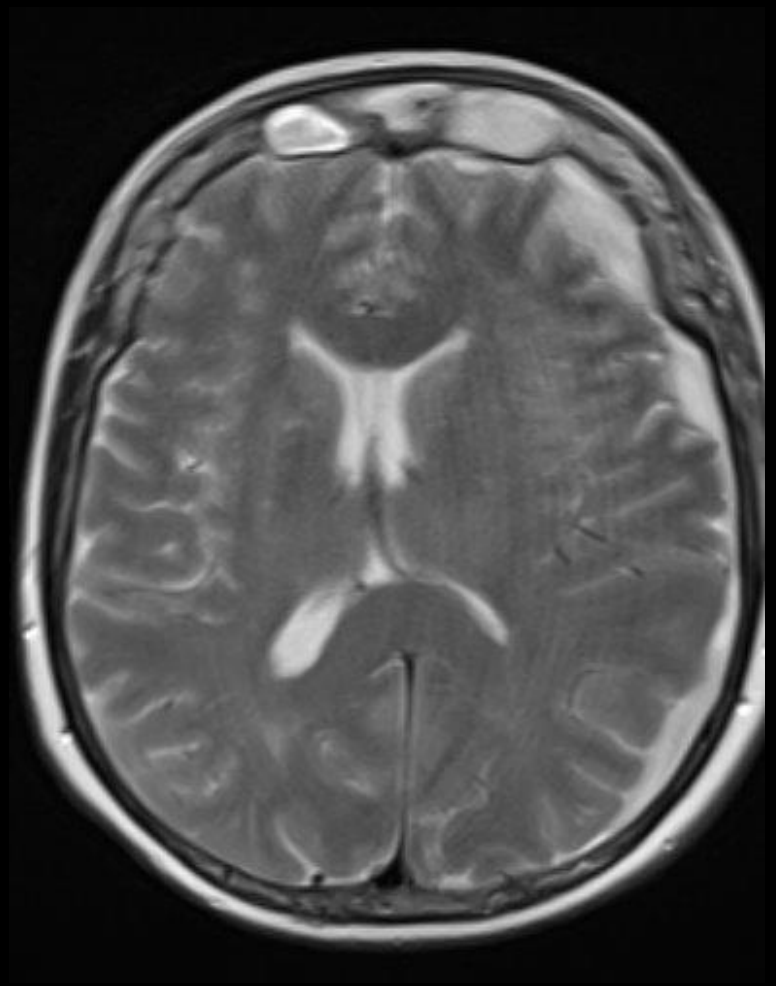


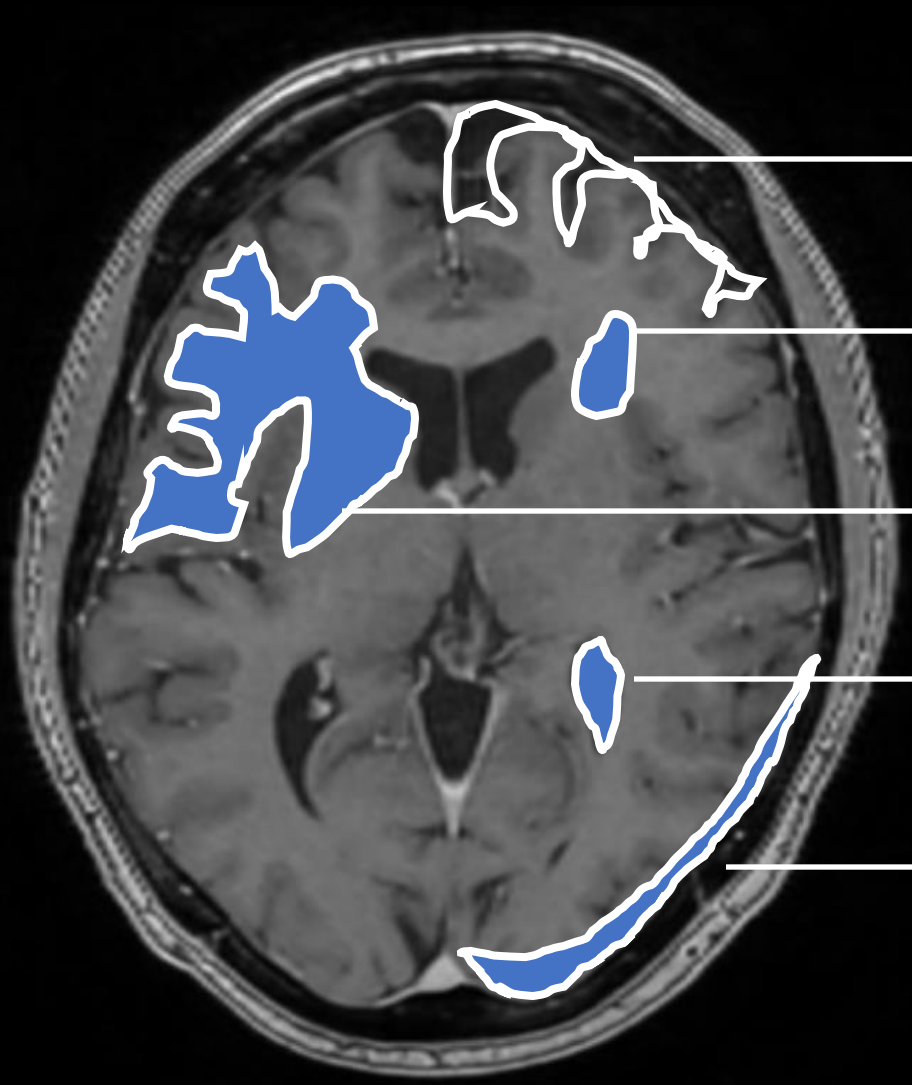

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1 Acquire (and scrutinize) the right sequences

DWI T1 + Gd (FLAIR + Gd can be helpful)

2 Known your imaging (enhancement) patterns

Abscess HSV encephalitis

Always correlate with history and clinical findings

3 Look for complications and origin

Arteritis / infarct, hydrocephalus, ventriculitis, empyema, venous sinus thrombosis

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TRAUMA & EMERGENCY RADIOLOGY

Thank you

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Department of Radiology

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