

# IMAGING OF CNS TUBERCULOSIS

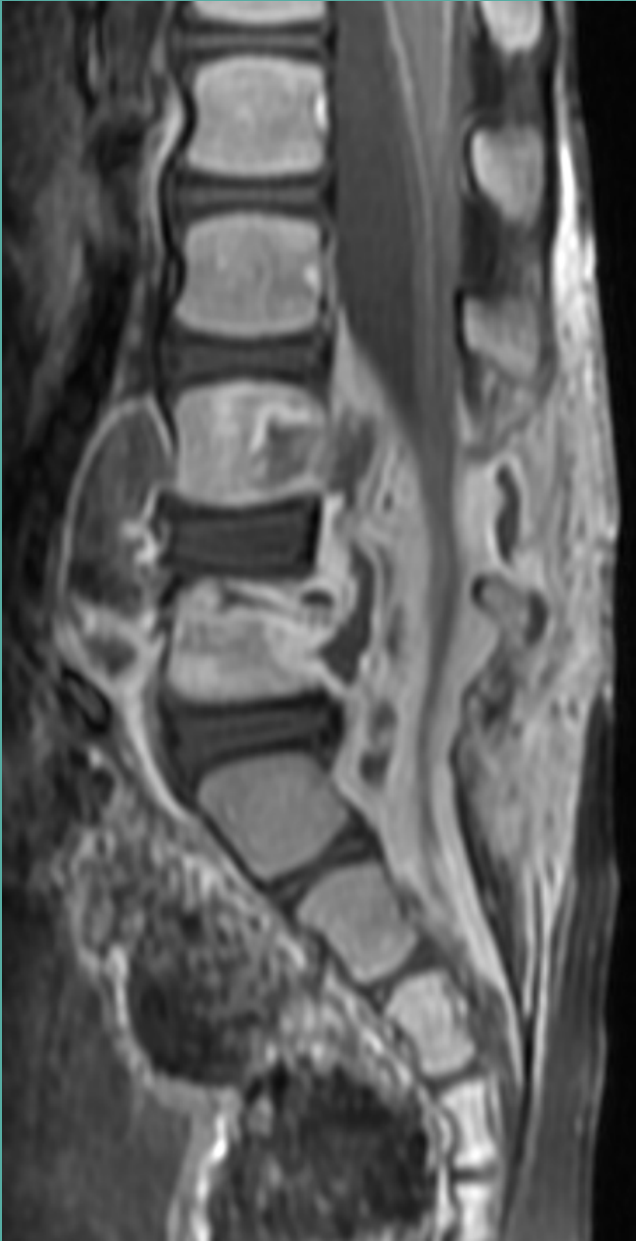
Aaron Field, MD, PhD

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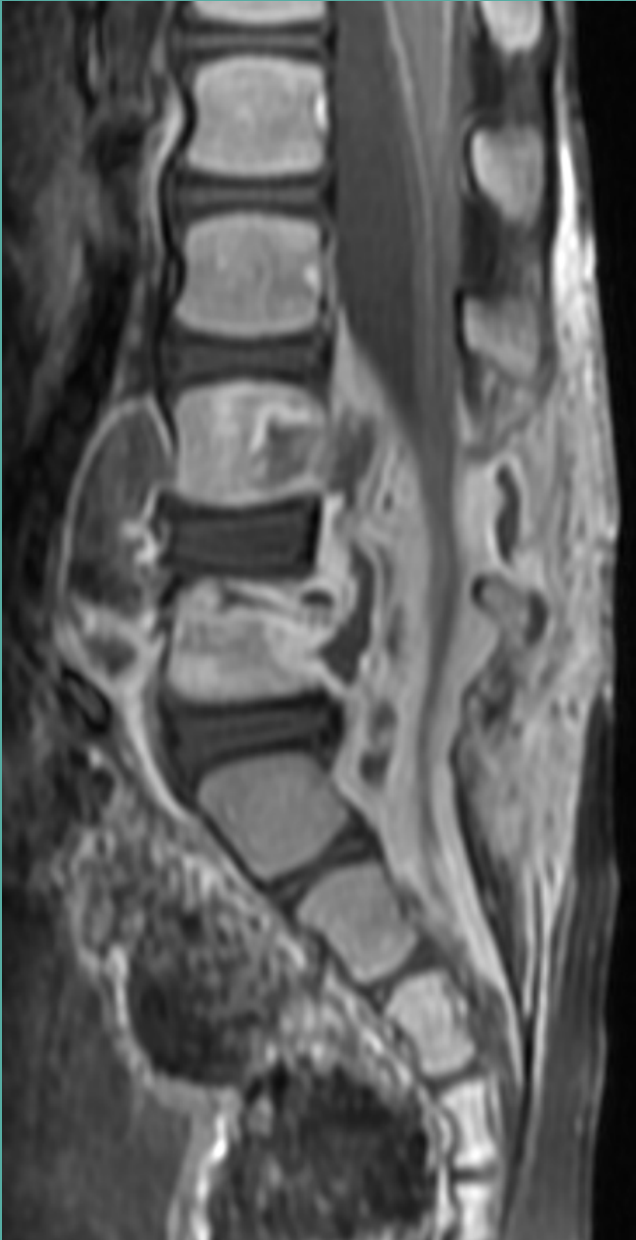
Wisconsin Virtual TB Summit : TB Radiology

April 28, 2026



## LEARNING OBJECTIVES

- Review spectrum of CNS manifestations of TB infection
- Recognize characteristic imaging findings
- Review imaging differential diagnoses
- Review common complications of CNS TB

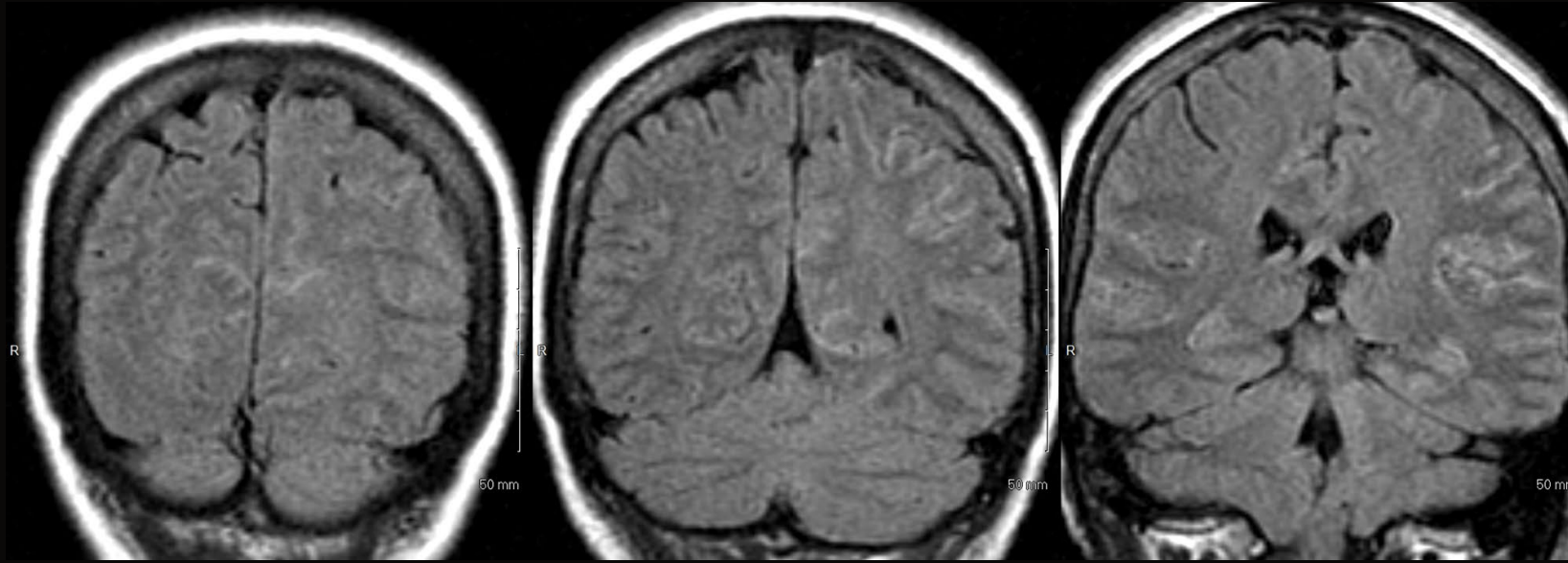


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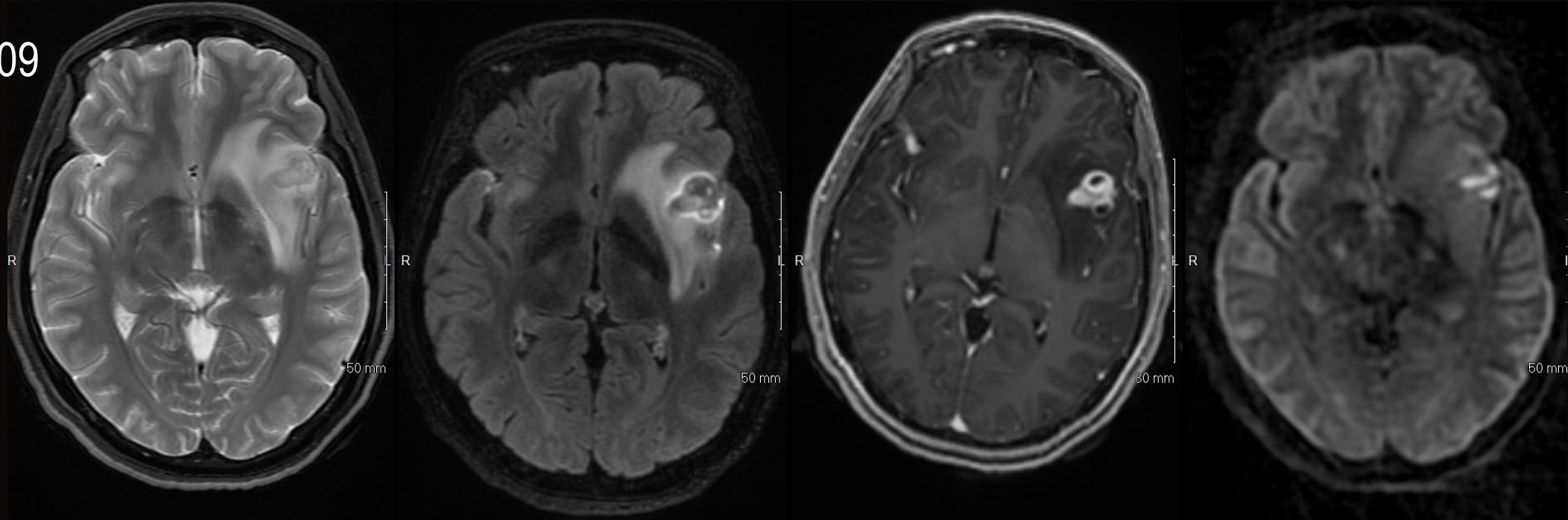
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# Case 1: 45 y/o woman w/ headache, fever, altered mental status

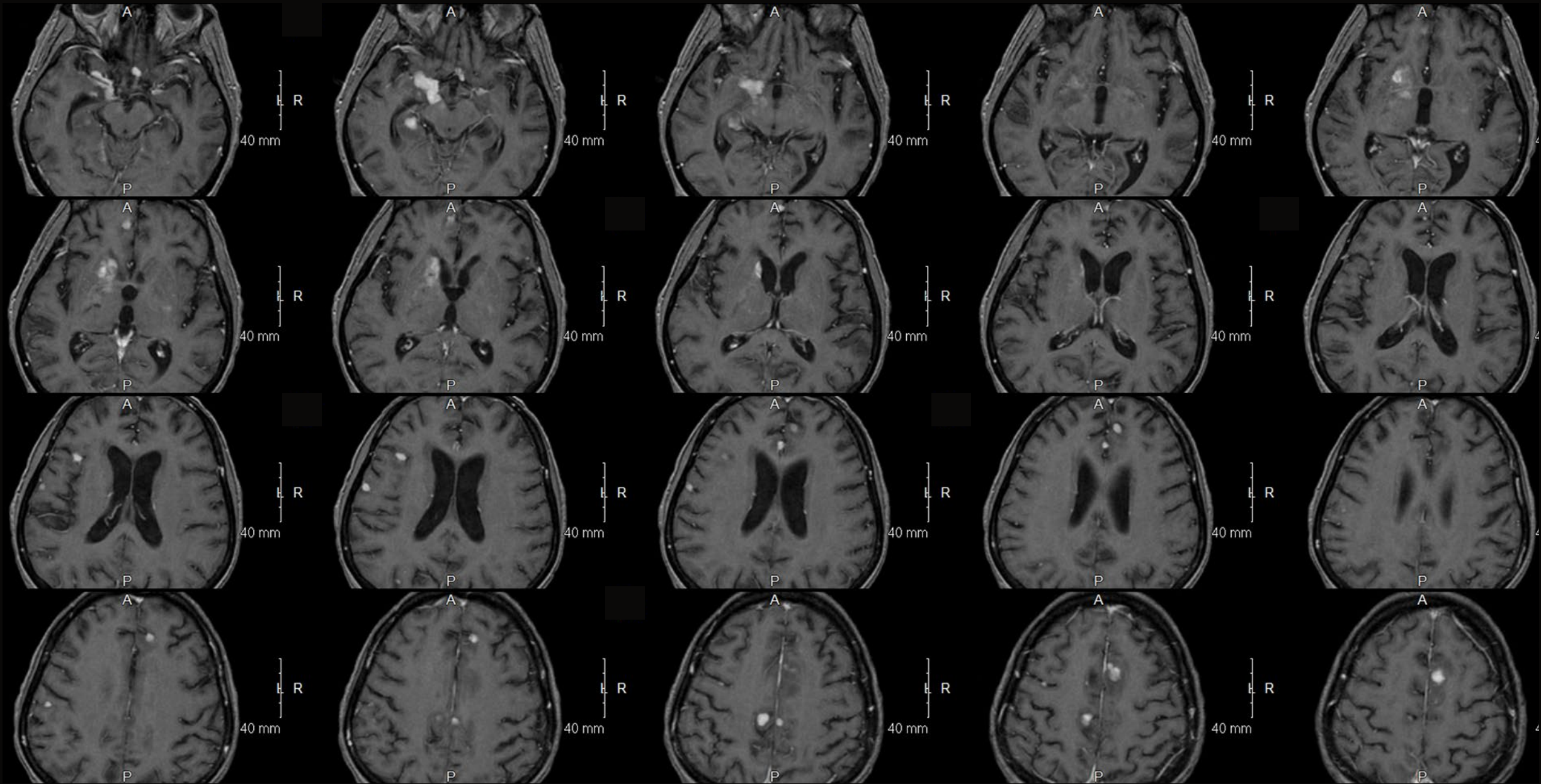
OCT 2009



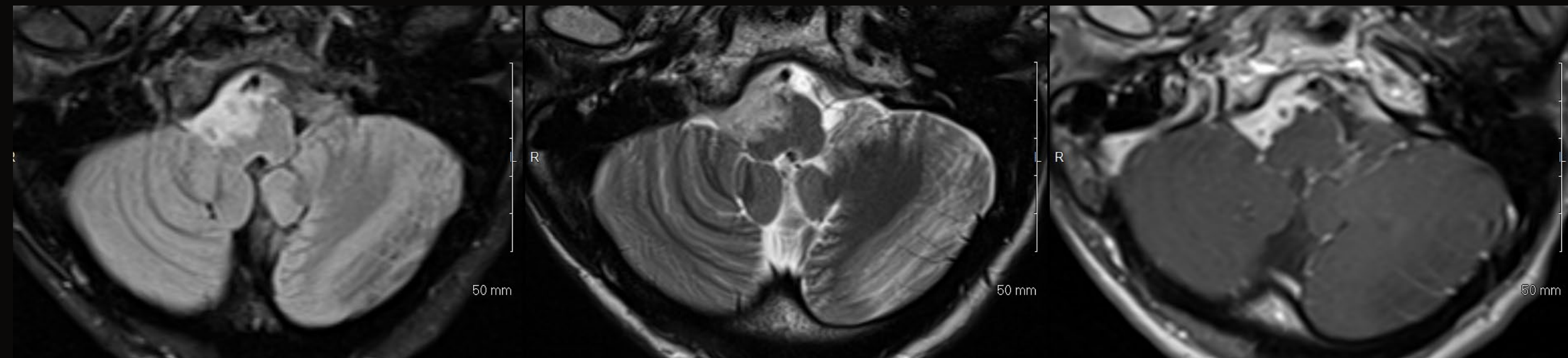
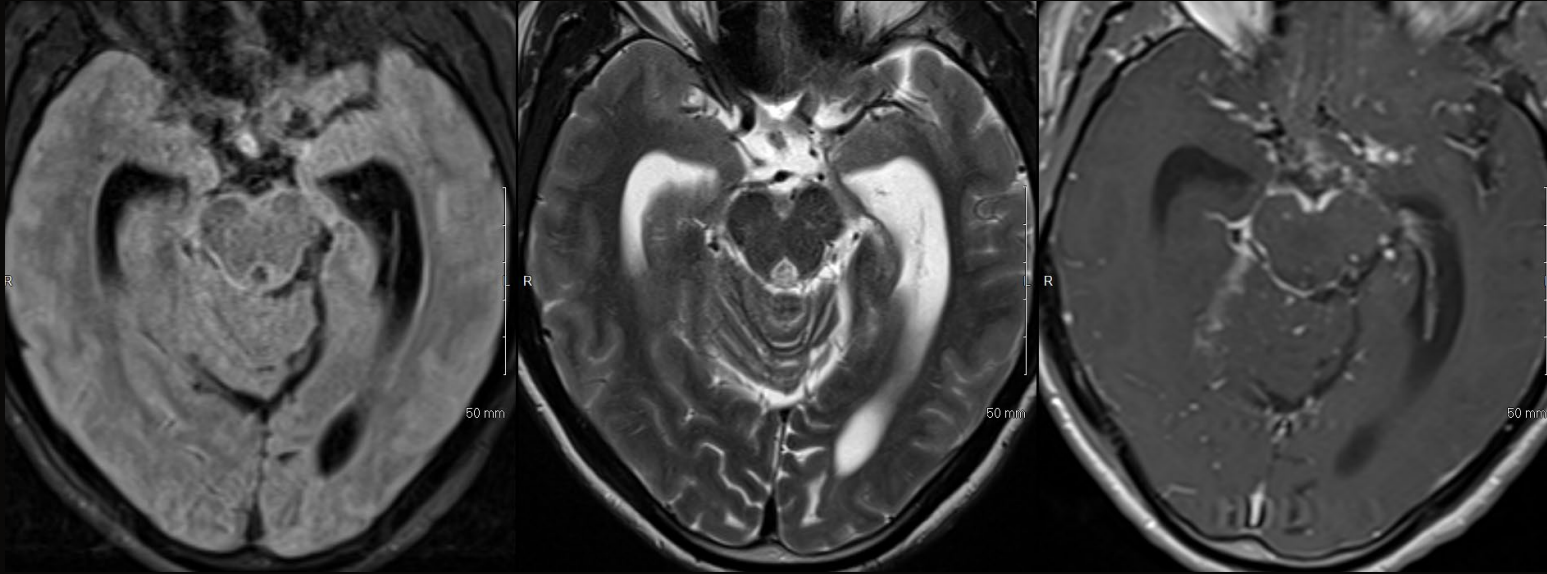
DEC 2009



# Case 2: 51 y/o woman w/ disseminated TB and new AMS



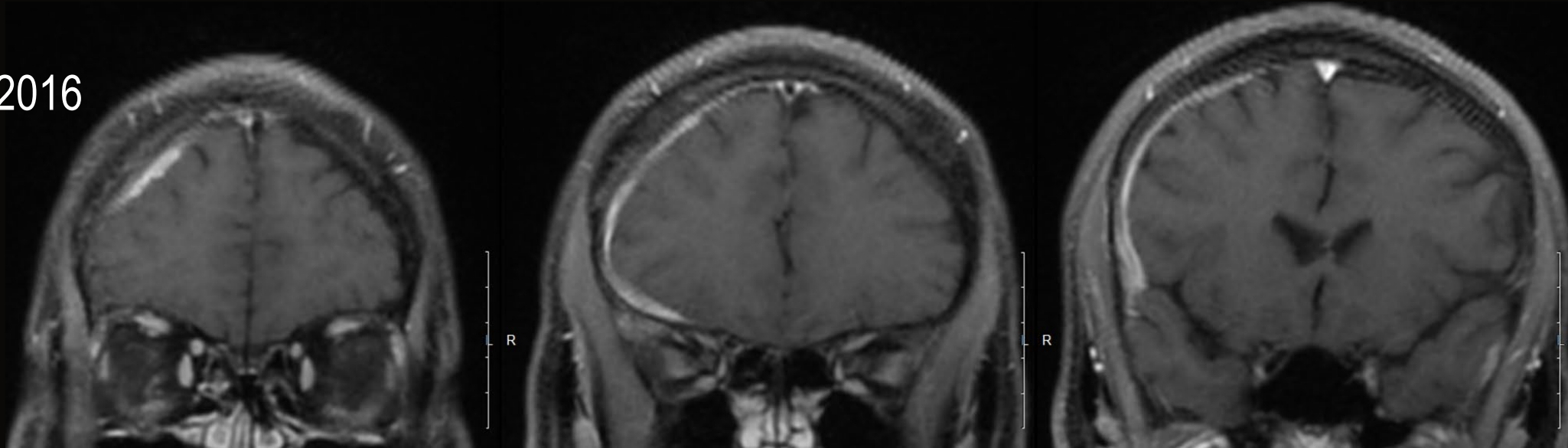
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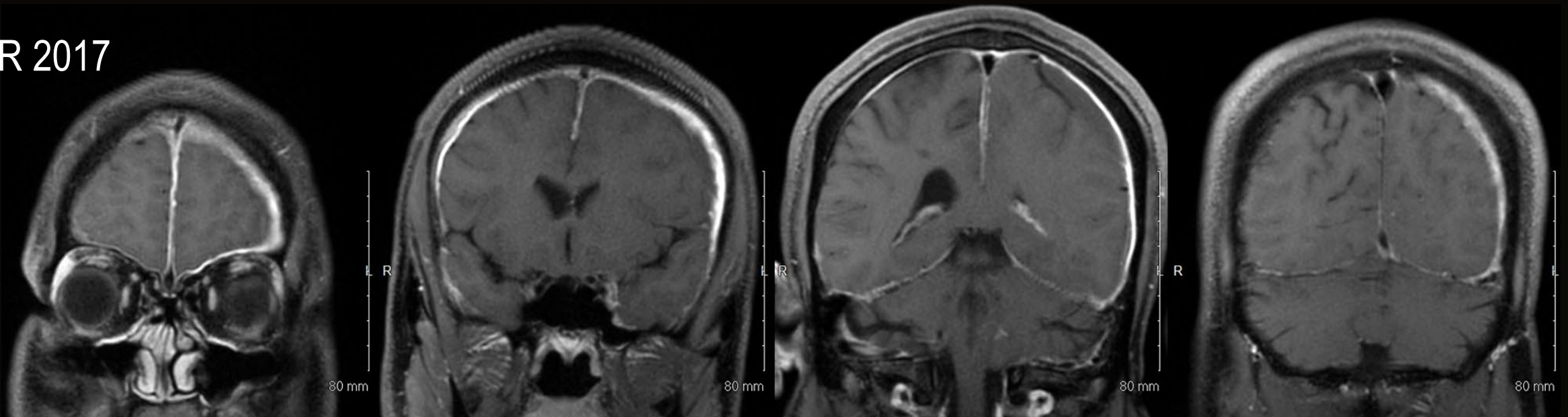
c/o Elizabeth Ann Misch MD, UW - Madison

# Case 4: 37 y/o man with headache

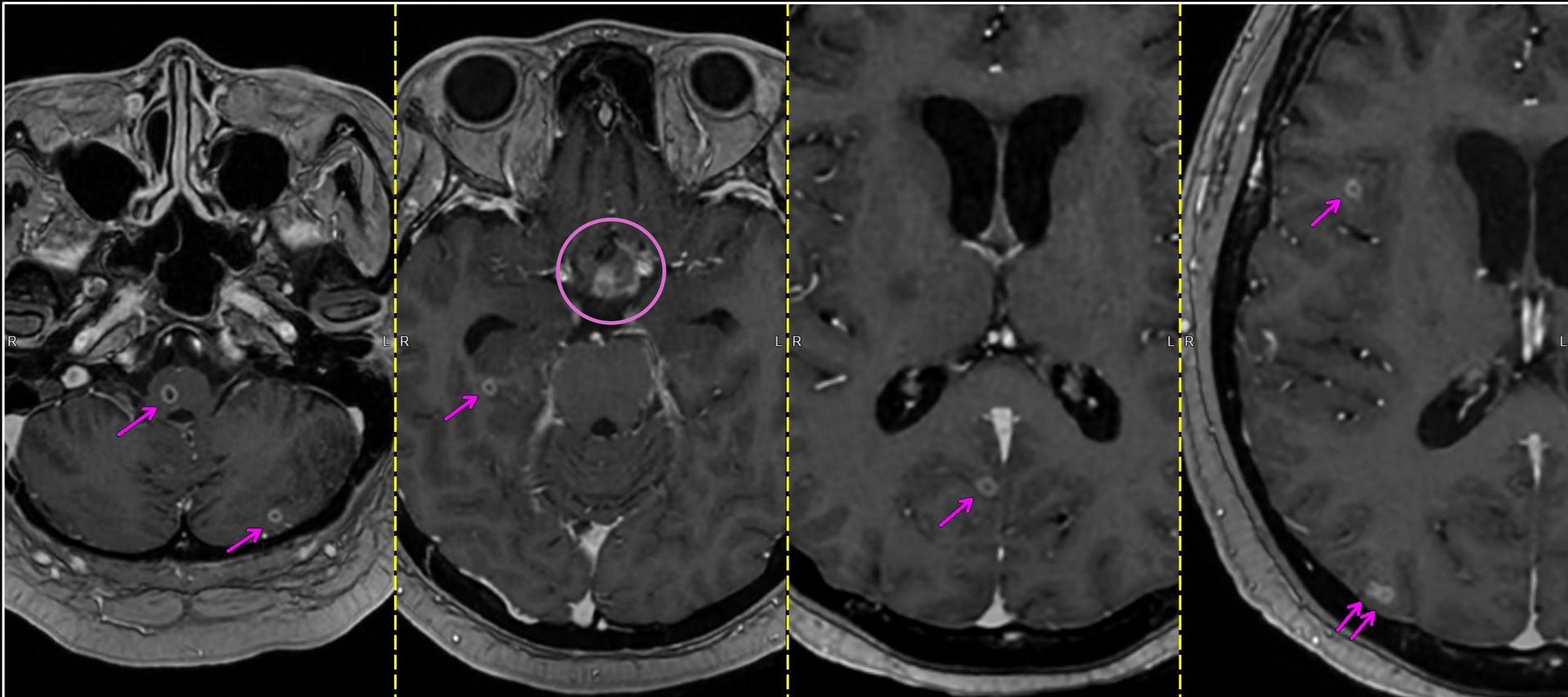
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APR 2017

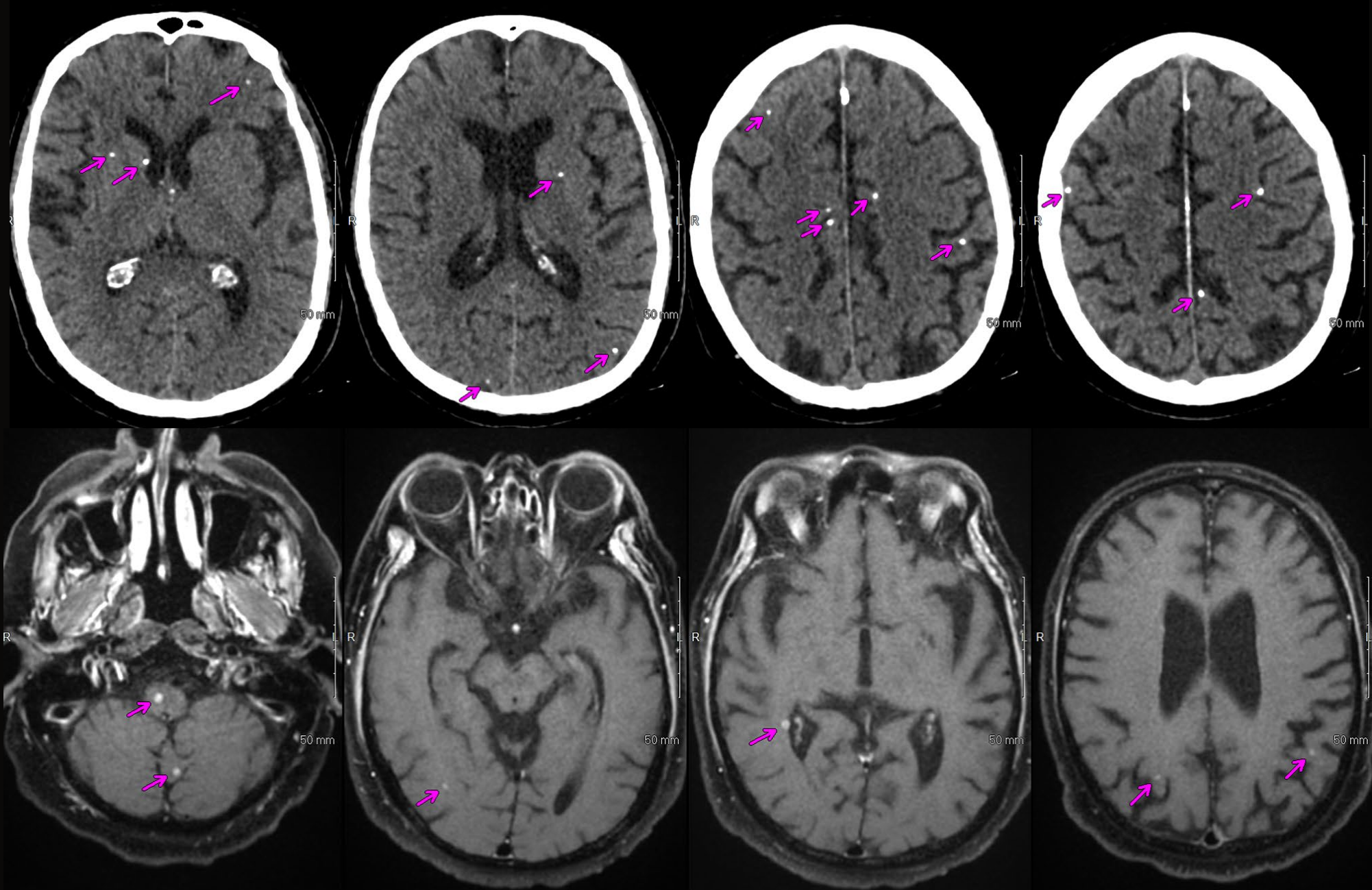


# Case 5: 43 y/o woman with fever, LE weakness, AMS, hyponatremia

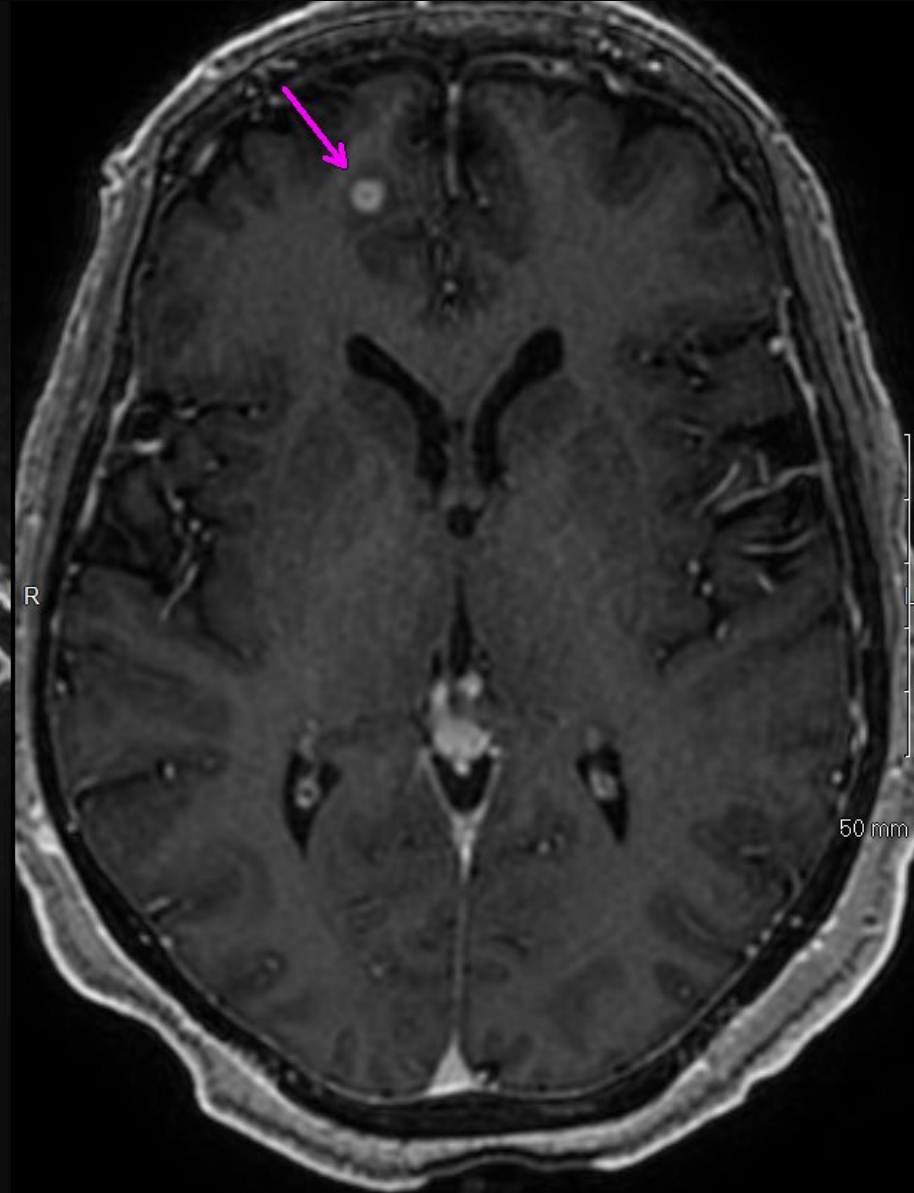
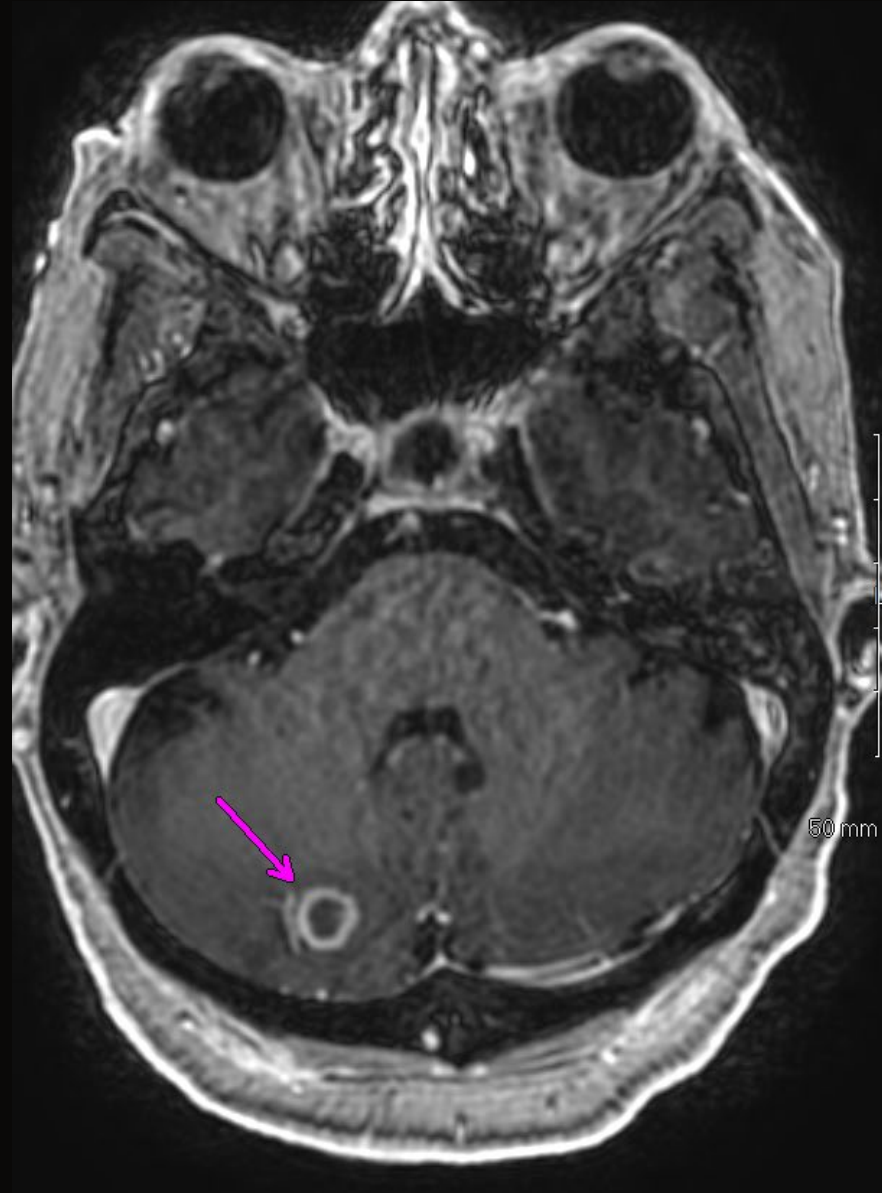
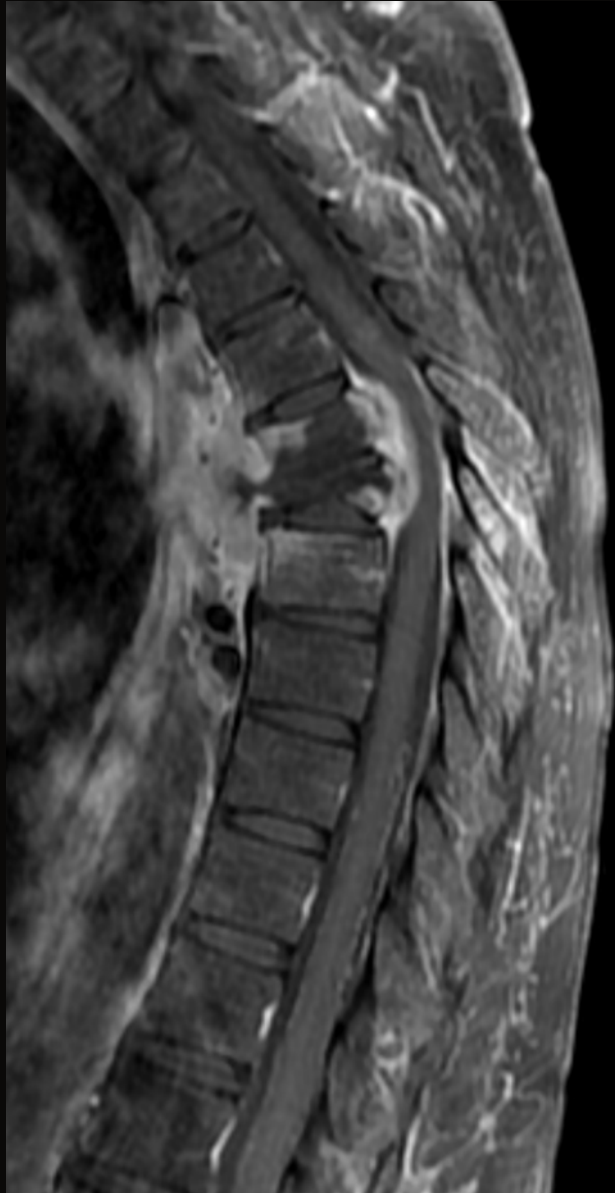


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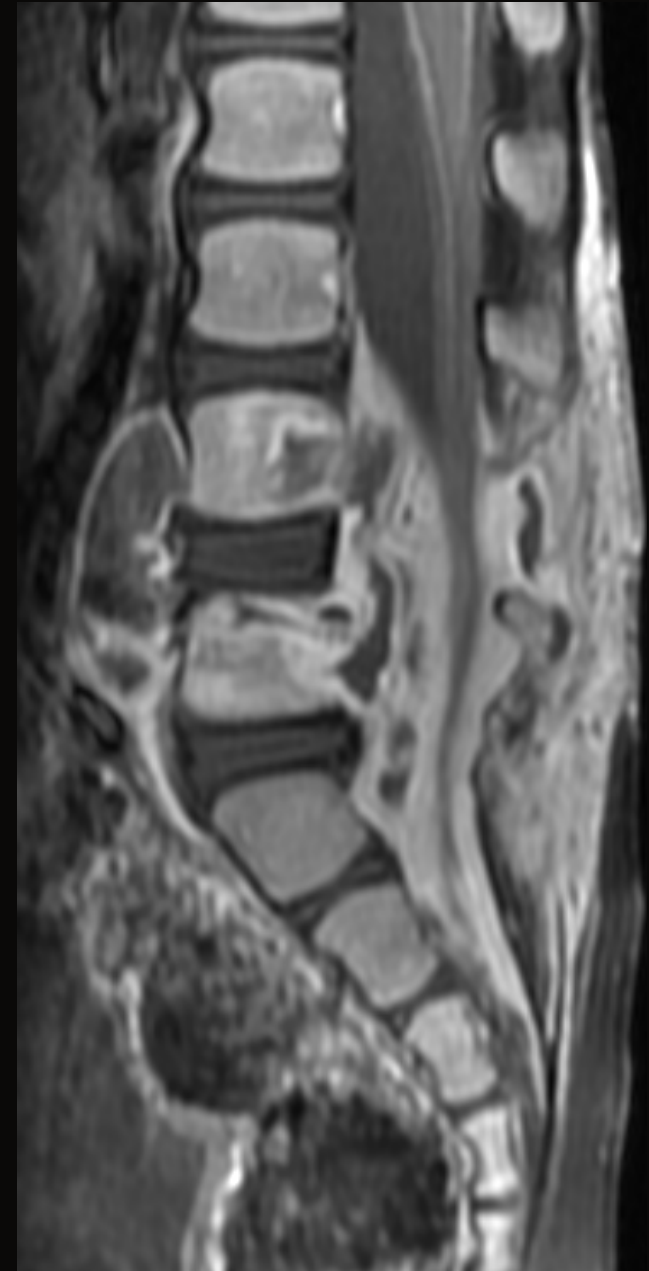
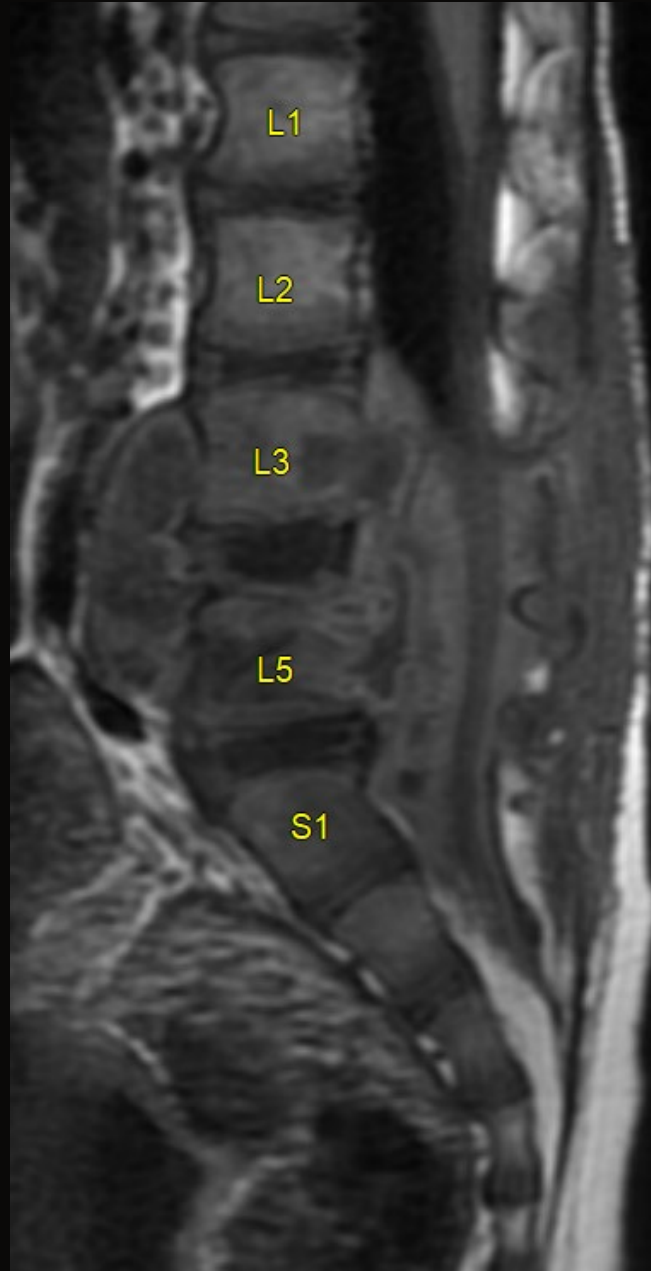
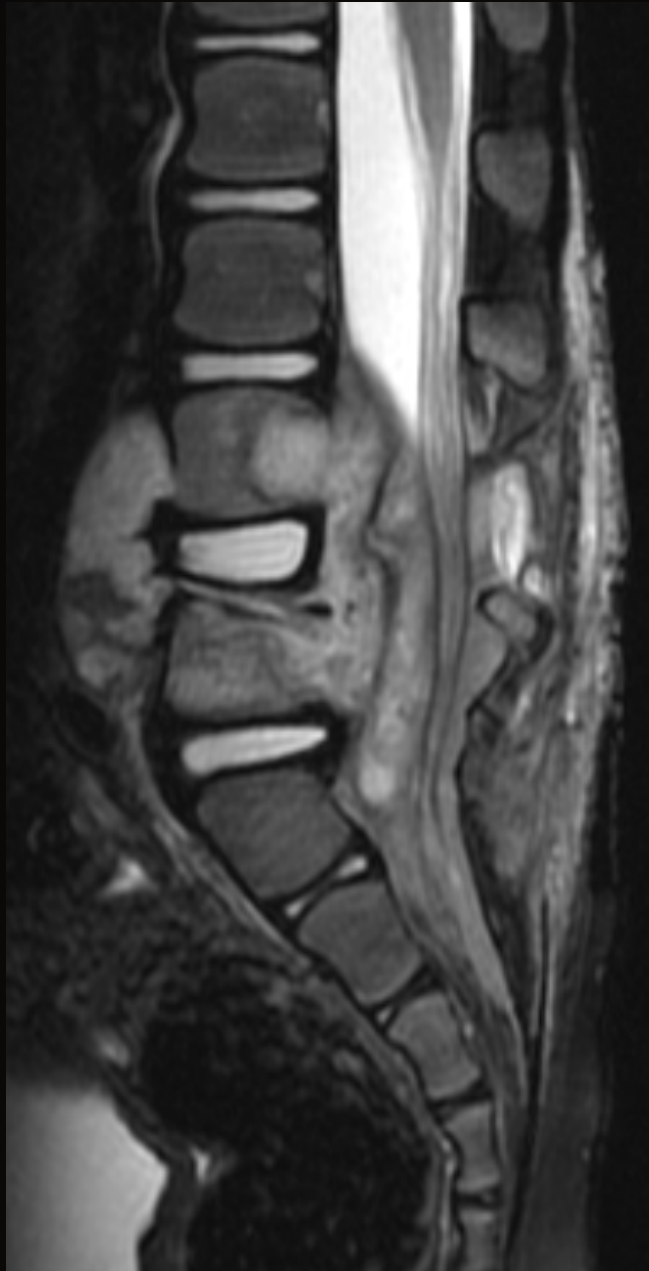
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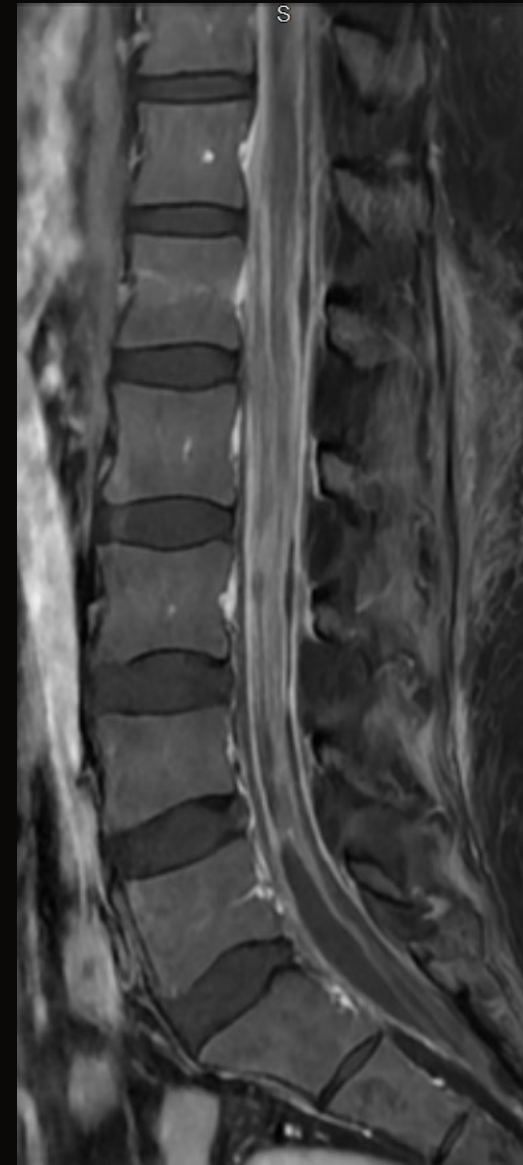
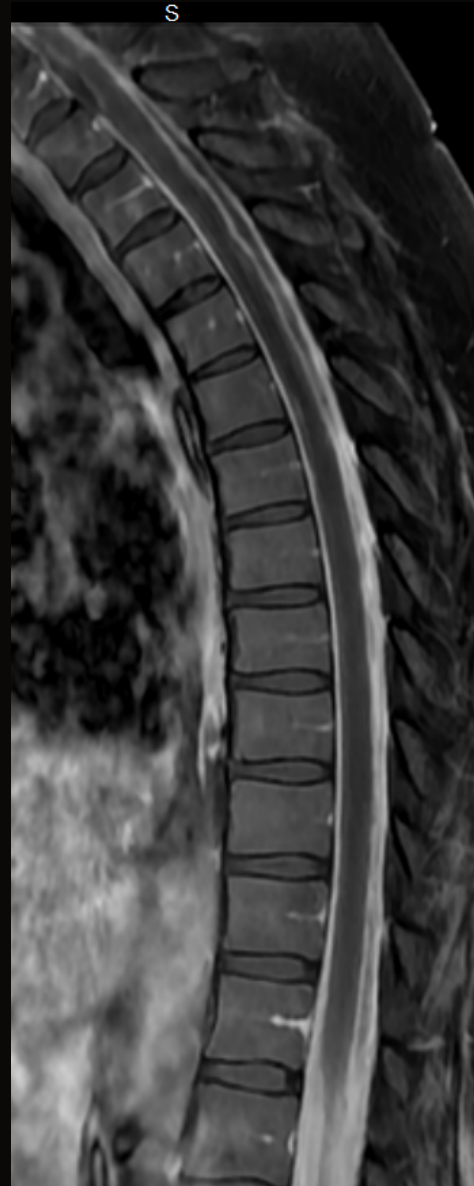
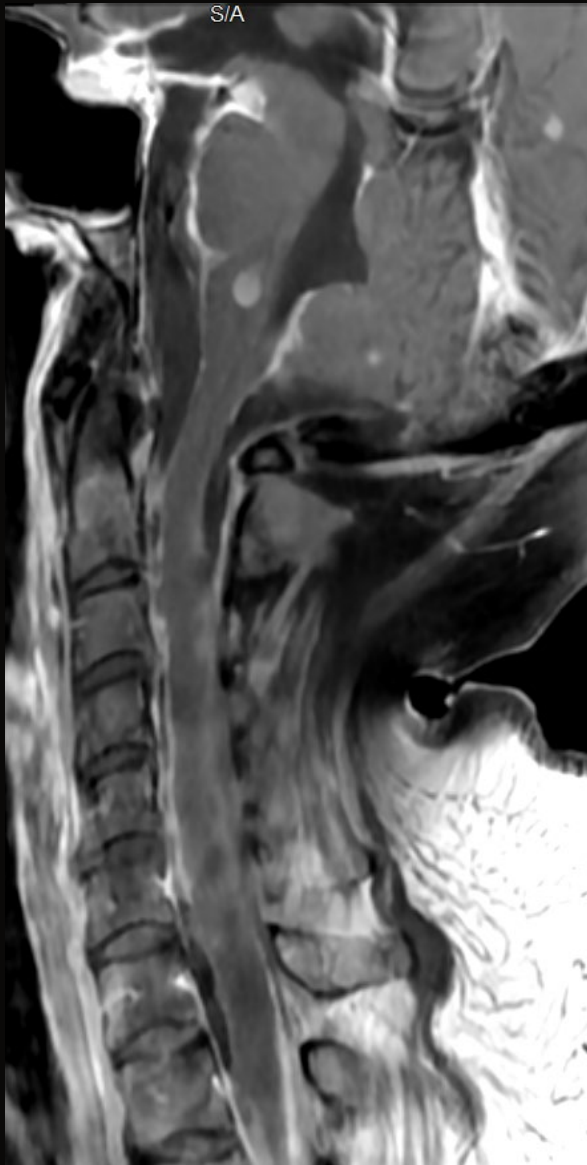
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# Case 9: 43 y/o woman with fever, LE weakness, AMS, hyponatremia



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# Spectrum of CNS Tuberculosis

- Meningeal TB

- Leptomeningitis (most common of all)
- Pachymeningitis (TB of the dura)

- Parenchymal TB

- Tuberculous granuloma (tuberculoma)
- Miliary tuberculomas
- Tuberculous abscess
- Tuberculous cerebritis
- Tuberculous encephalopathy

- Spinal TB

- Tuberculous spondylitis (Pott's)(most common spinal TB)
- Tuberculous meningitis, (radiculo)myelitis, arachnoiditis
- Spinal cord tuberculoma, abscess

- Miscellaneous

- TB hypophysitis
- Orbital TB
- TB otomastoiditis
- TB osteomyelitis skull base, calvarium

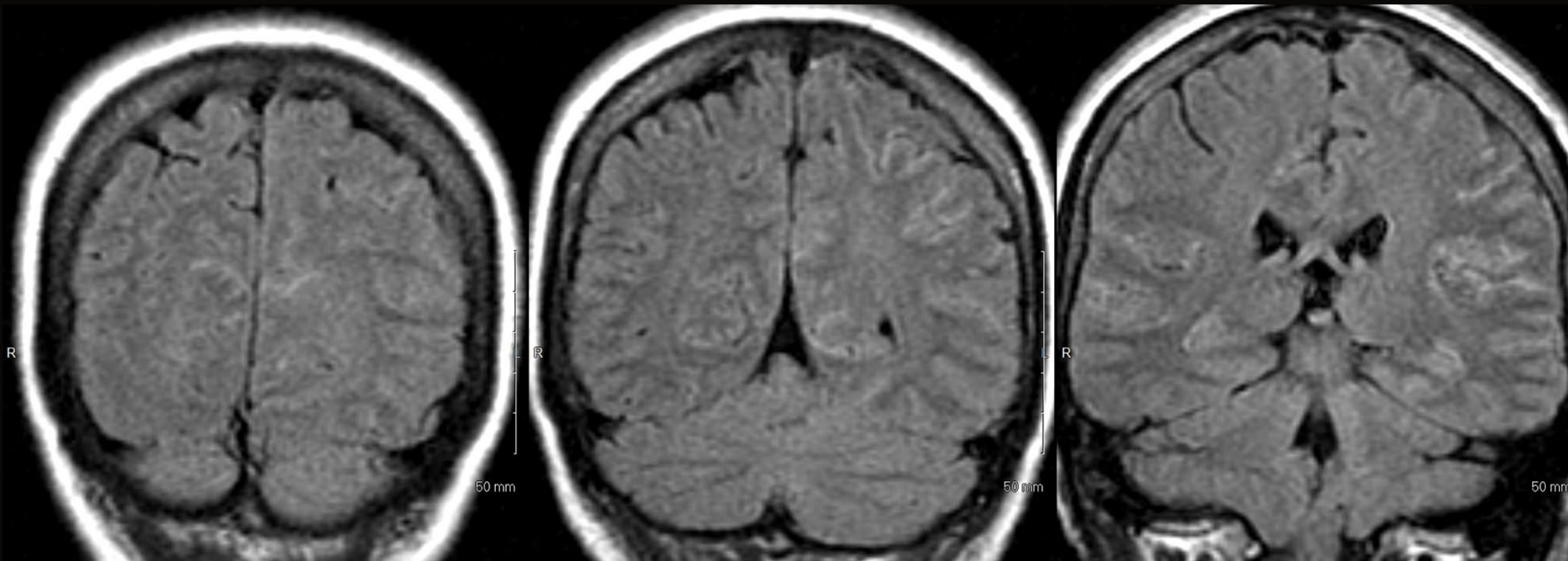
10% of TB cases overall  
20% of TB cases in immunocompromised

# Meningeal TB: Tuberculous Leptomeningitis

- Most common (70-80% of all CNS TB)
- Often children, adolescents
- Most often linked to complications
- Pathophysiology:
  - Hematogenous spread to pia-arachnoid → subpial “Rich focus” (Rich & McCordock, 1933)
  - Rich foci rupture into subarachnoid space → intense granulomatous inflammation
  - Thick exudate (esp. basal cisterns; non-CSF MRI signal + enhancement)
- Complications:
  - Hydrocephalus (communicating)
  - Vasculitis
  - Ischemic infarction (esp. basal ganglia, internal capsules)
  - Cranial neuropathies (esp. II, III, IV, VII)

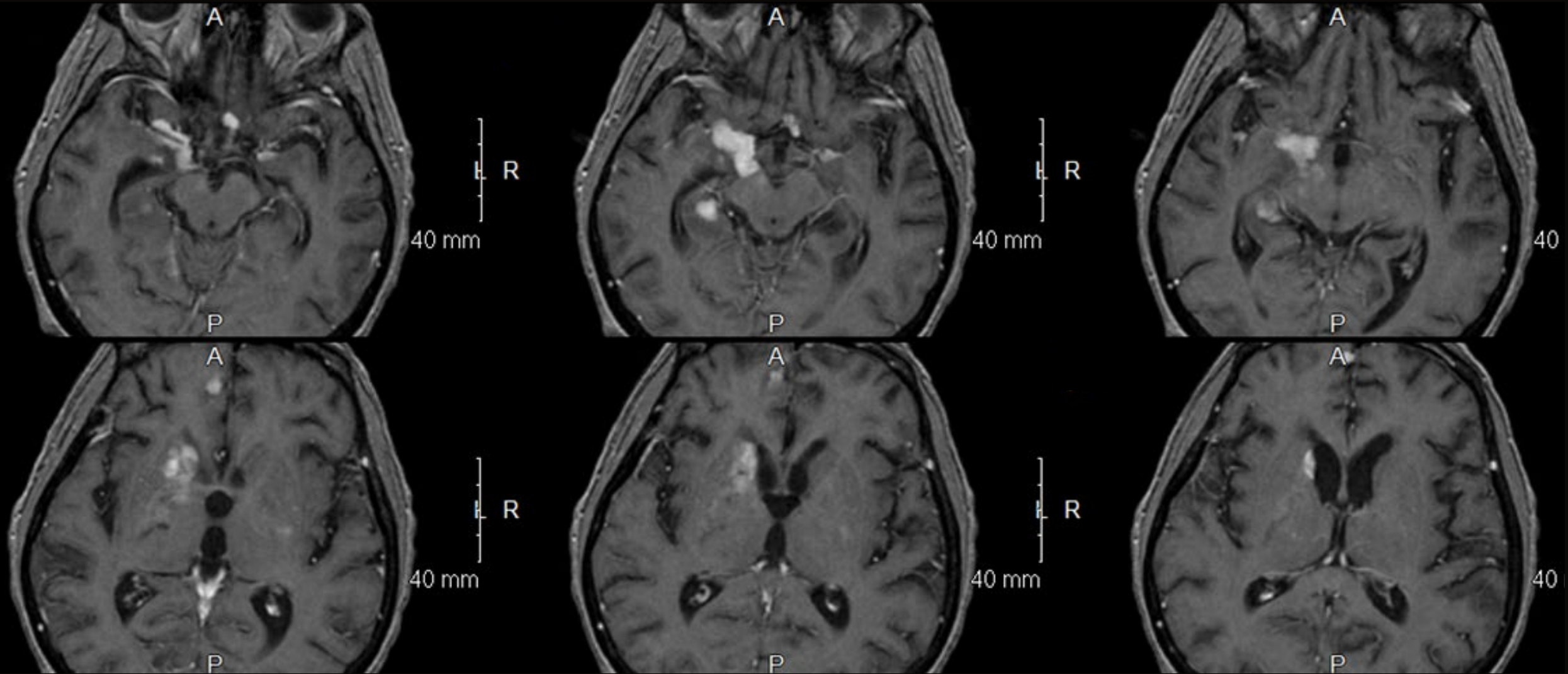
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## Leptomeningitis



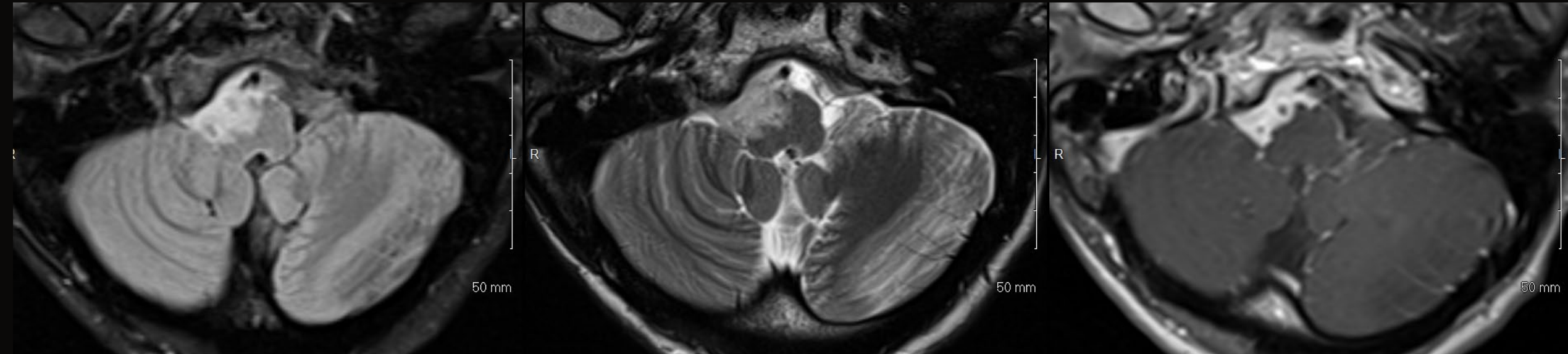
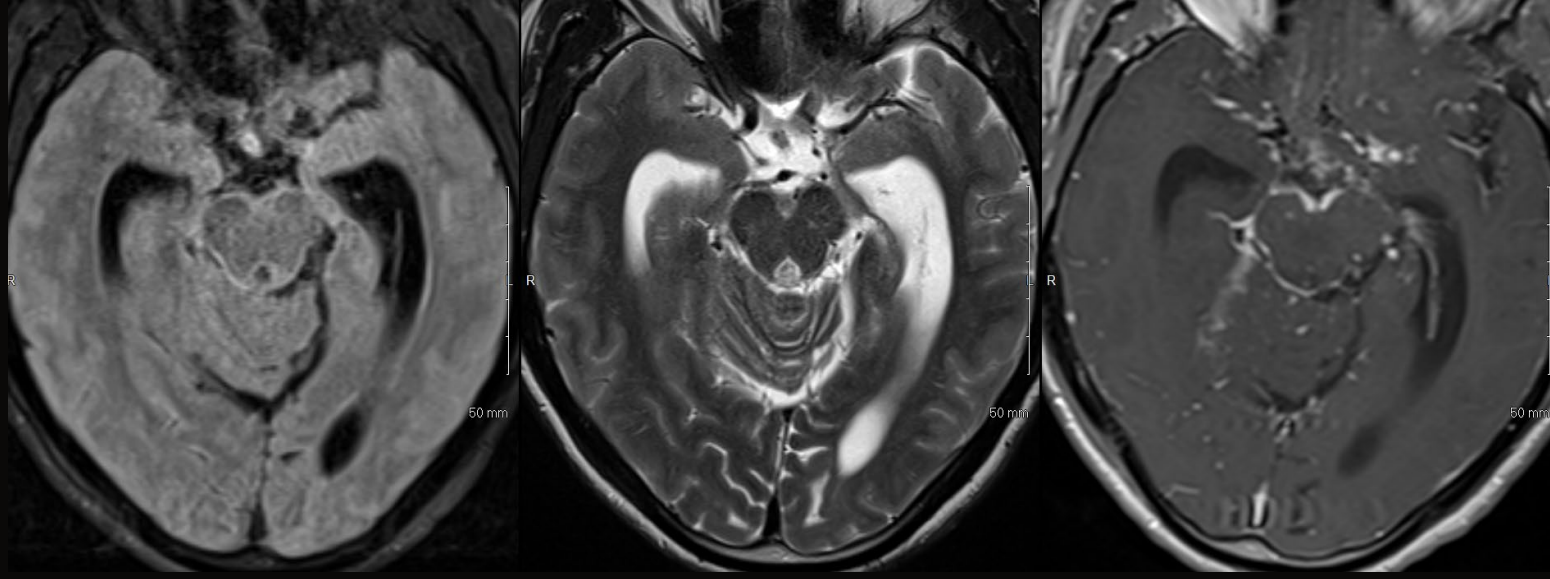
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## Leptomeningitis



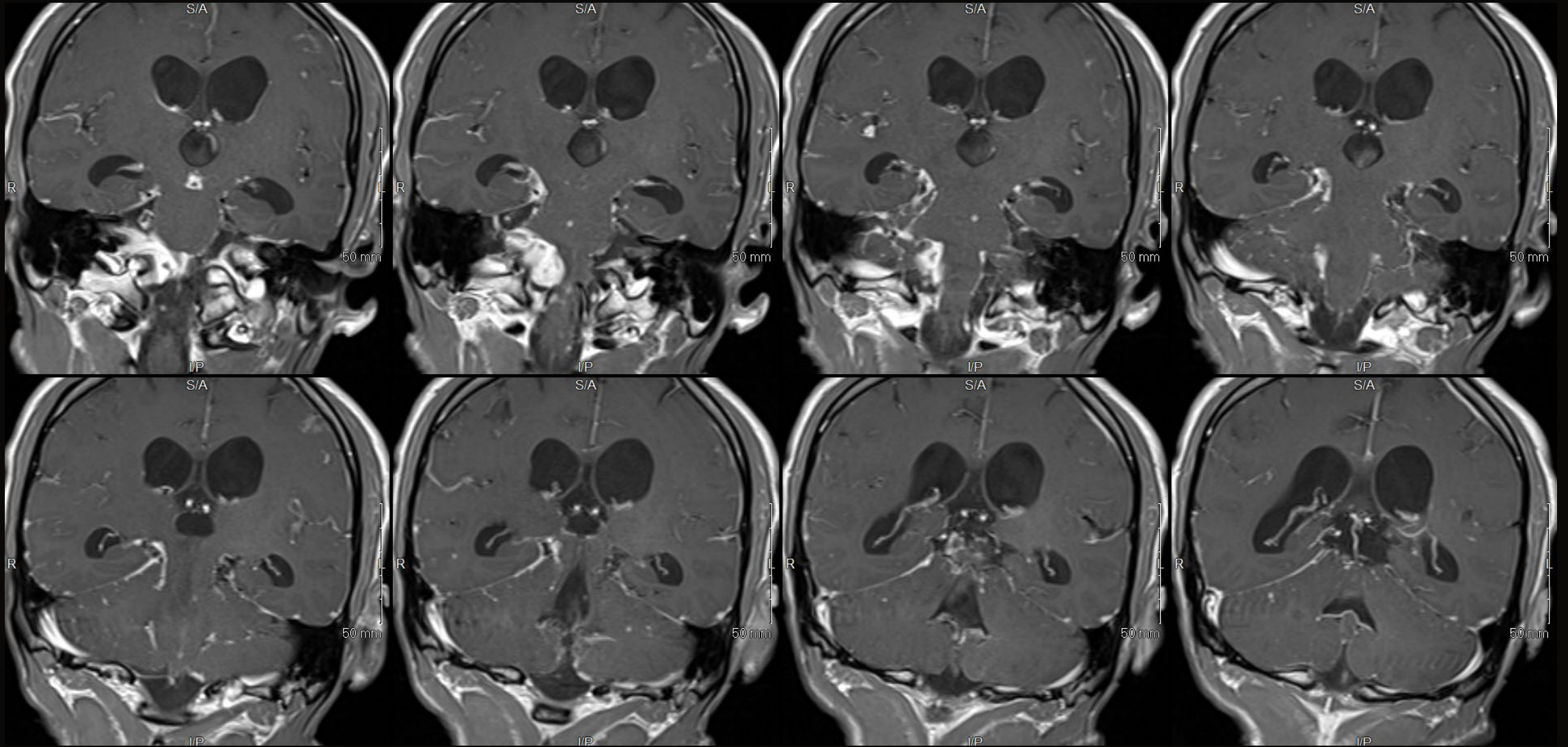
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Leptomeningitis w/ Communicating Hydrocephalus



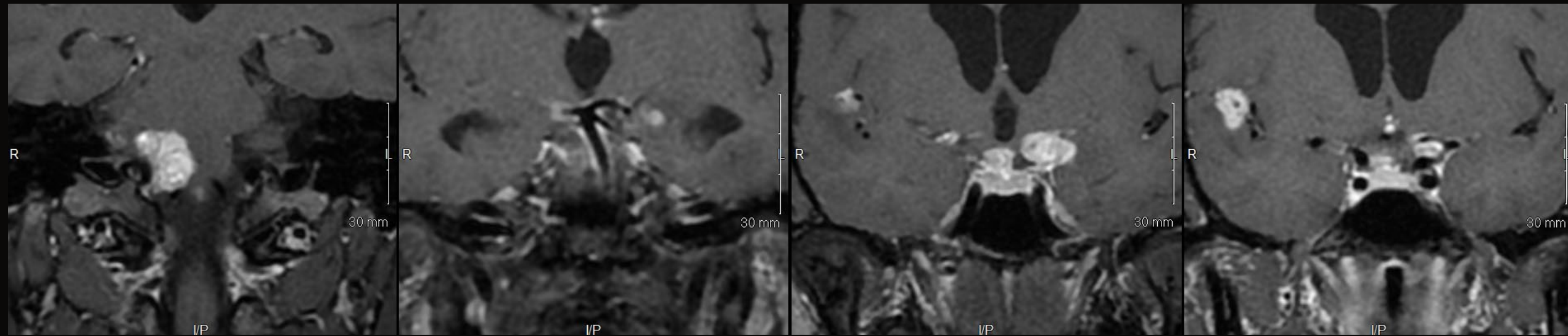
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## Leptomeningitis w/ Communicating Hydrocephalus



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## Leptomeningitis w/ Communicating Hydrocephalus



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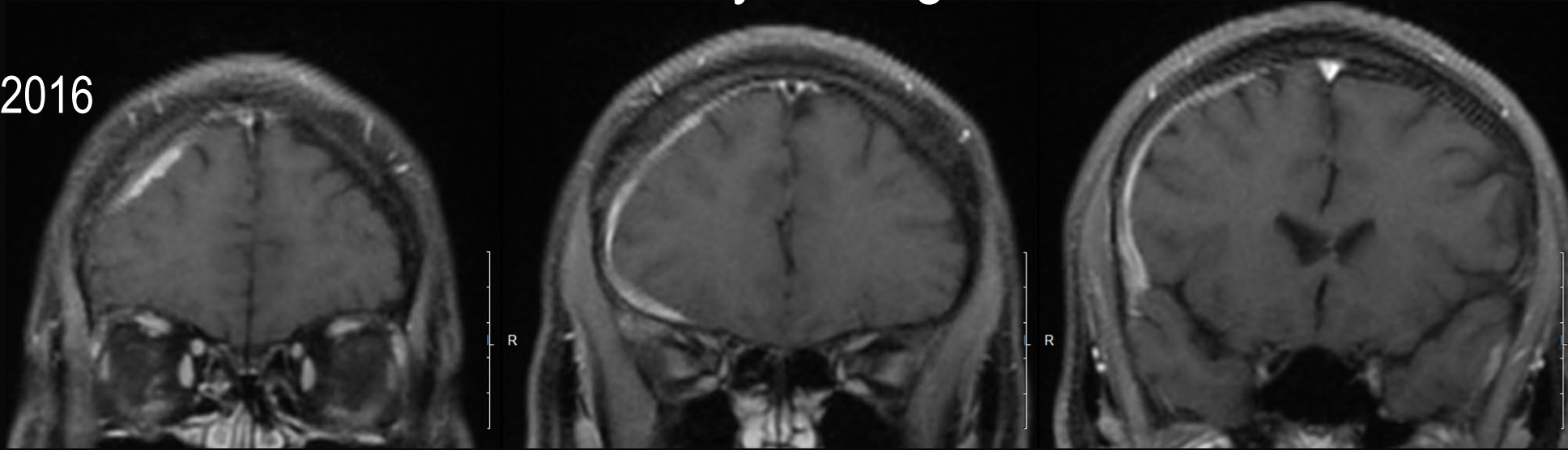
## Meningeal TB: Tuberculous Pachymeningitis (Dural TB)

- Much less common than leptomeningitis
- Dural-based tuberculoma – focal or diffuse, often “en plaque”
- Often results from direct spread of leptomeningitis
- Dural thickening, mass-like, may resemble meningioma

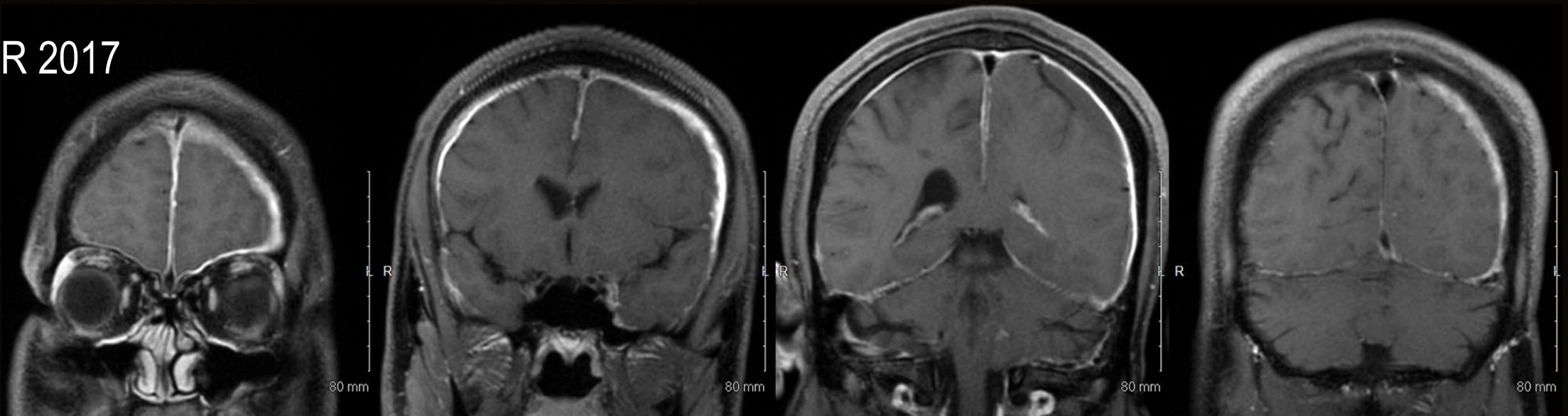
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## Pachymeningitis

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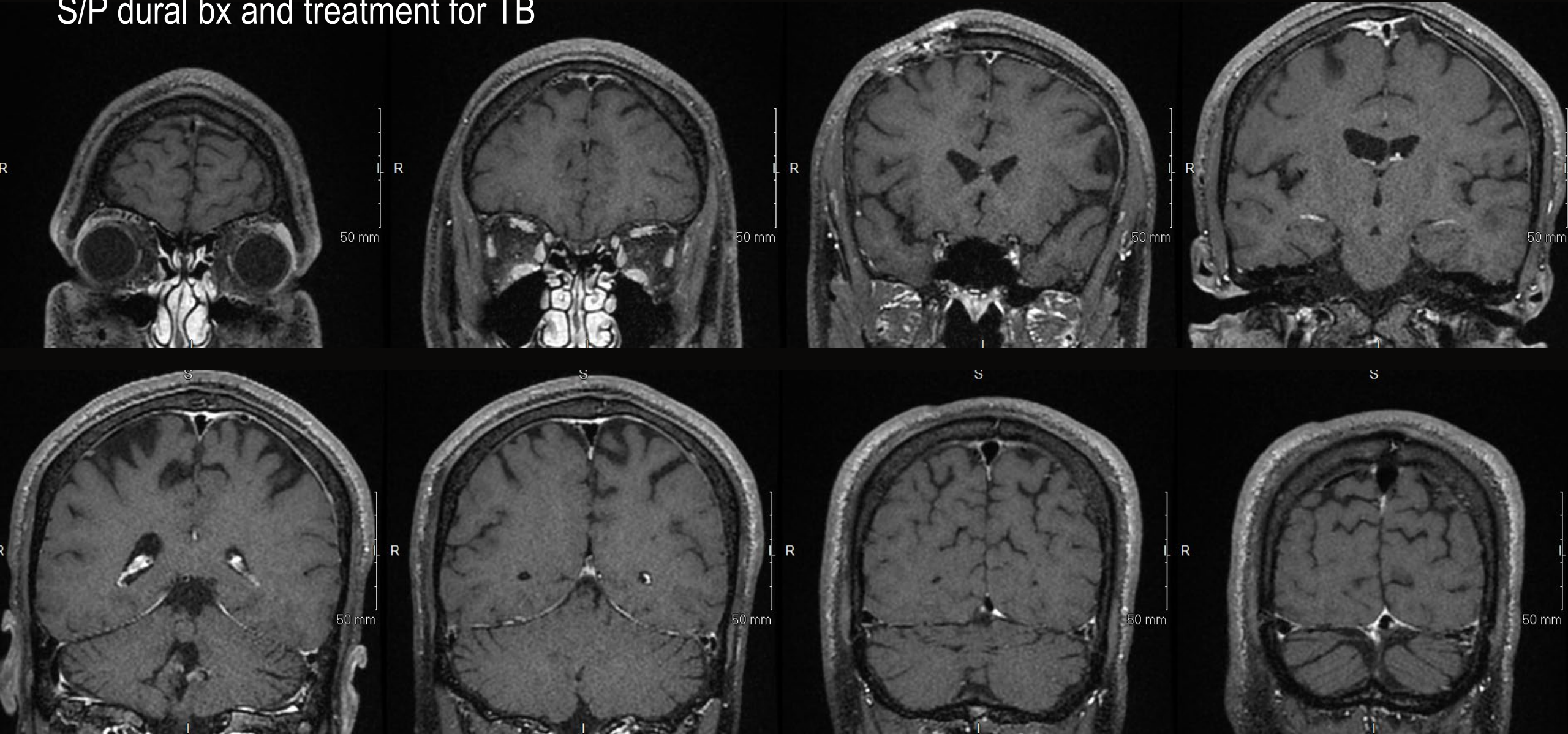


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# Case 4: 37 y/o man with headache

S/P dural bx and treatment for TB

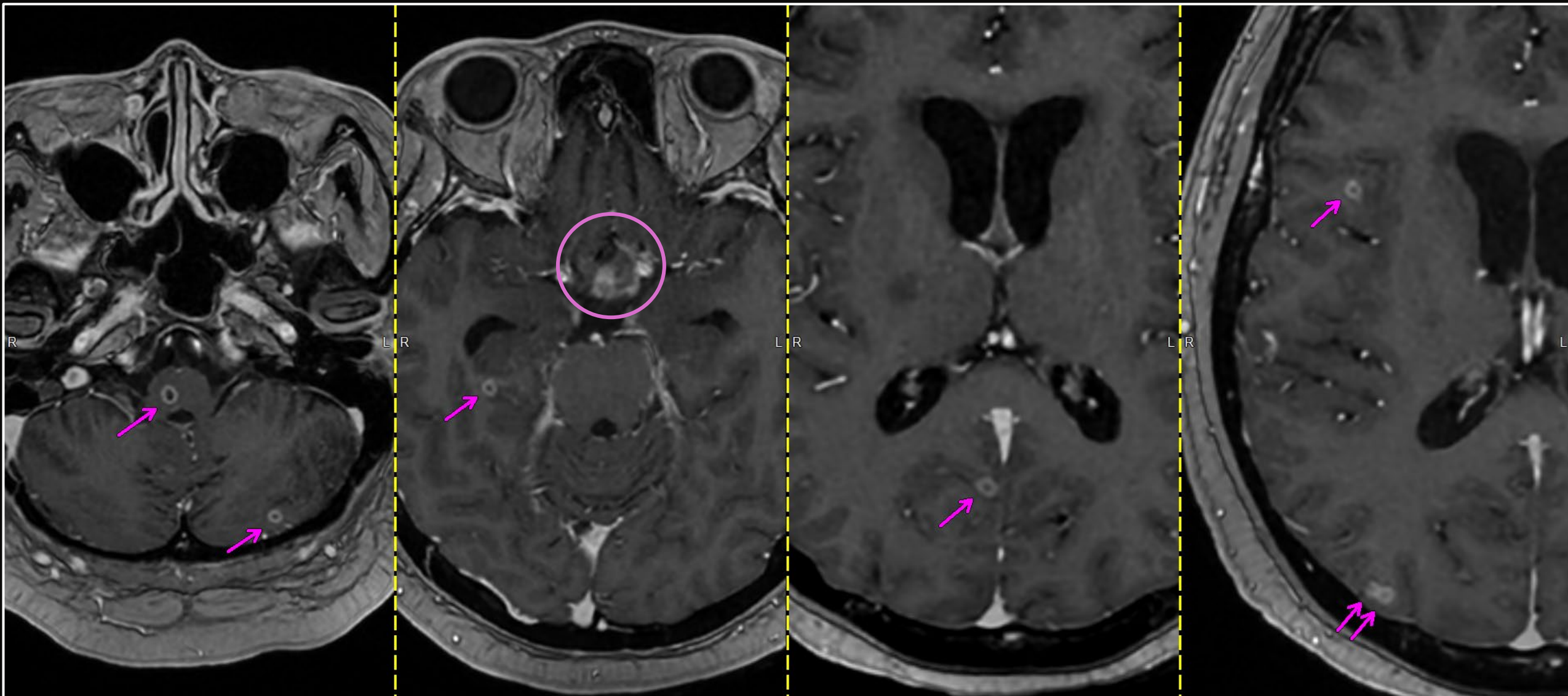


# Parenchymal TB: Tuberculous Granuloma (Tuberculoma)

- The most common parenchymal TB lesion
- Often (not always) accompanies TB meningitis
- Hematogenous spread to parenchyma → unruptured Rich foci develop as tuberculomas
- Adults typically supratentorial, peds infratentorial
- Solitary or multiple; often no neuro symptoms
- CSF analysis often unrevealing, cultures negative
- Four stages of development:
  - Non-caseating (solid enhancing MRI)
  - Caseating, solid center (ring enhancing, T2-hypointense)
  - Caseating, liquified center (not pus!)(ring-enhancing, T2-hyperintense, no diffusion restriction)
  - Calcified (CT good for these!)

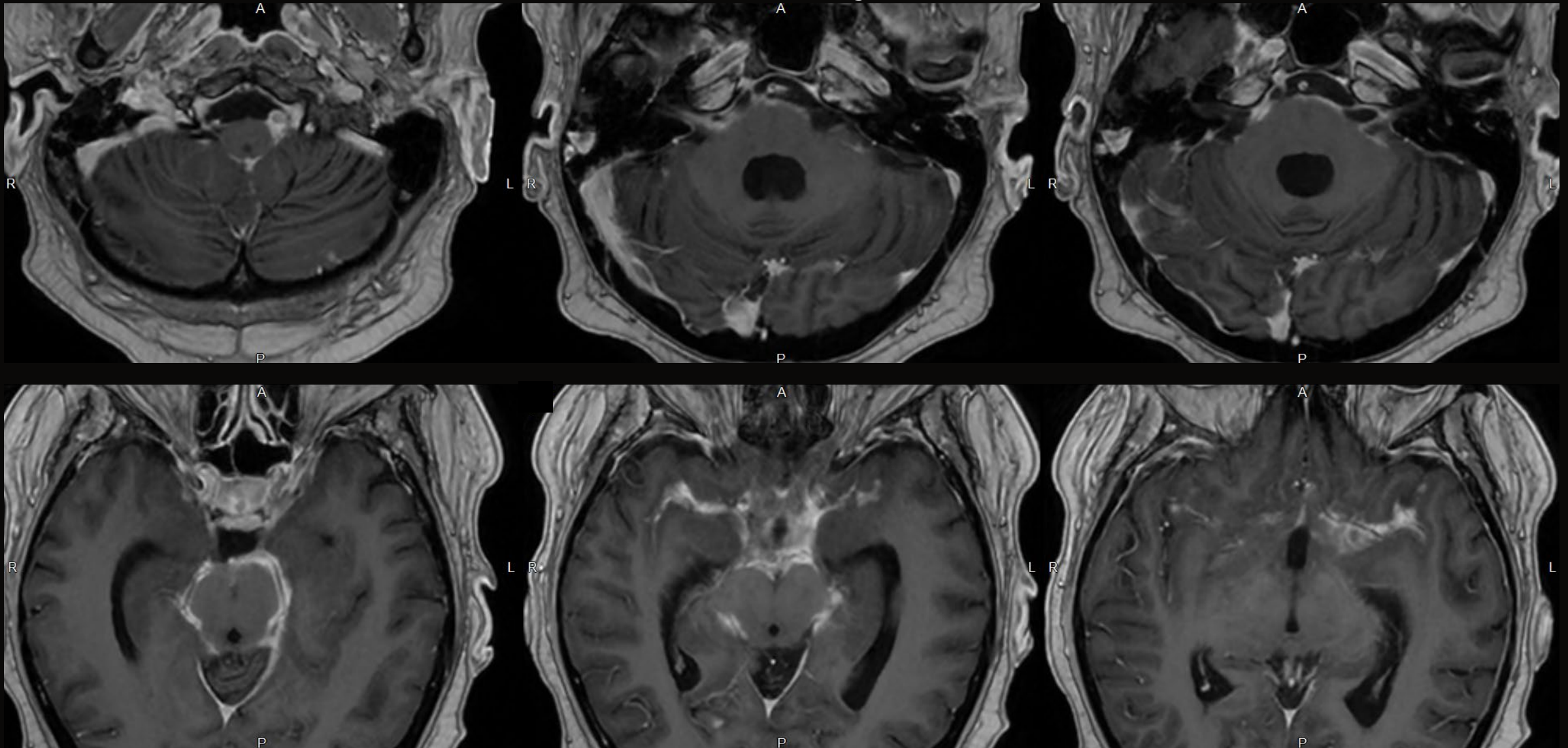
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Tuberculomas (caseating, liquified)



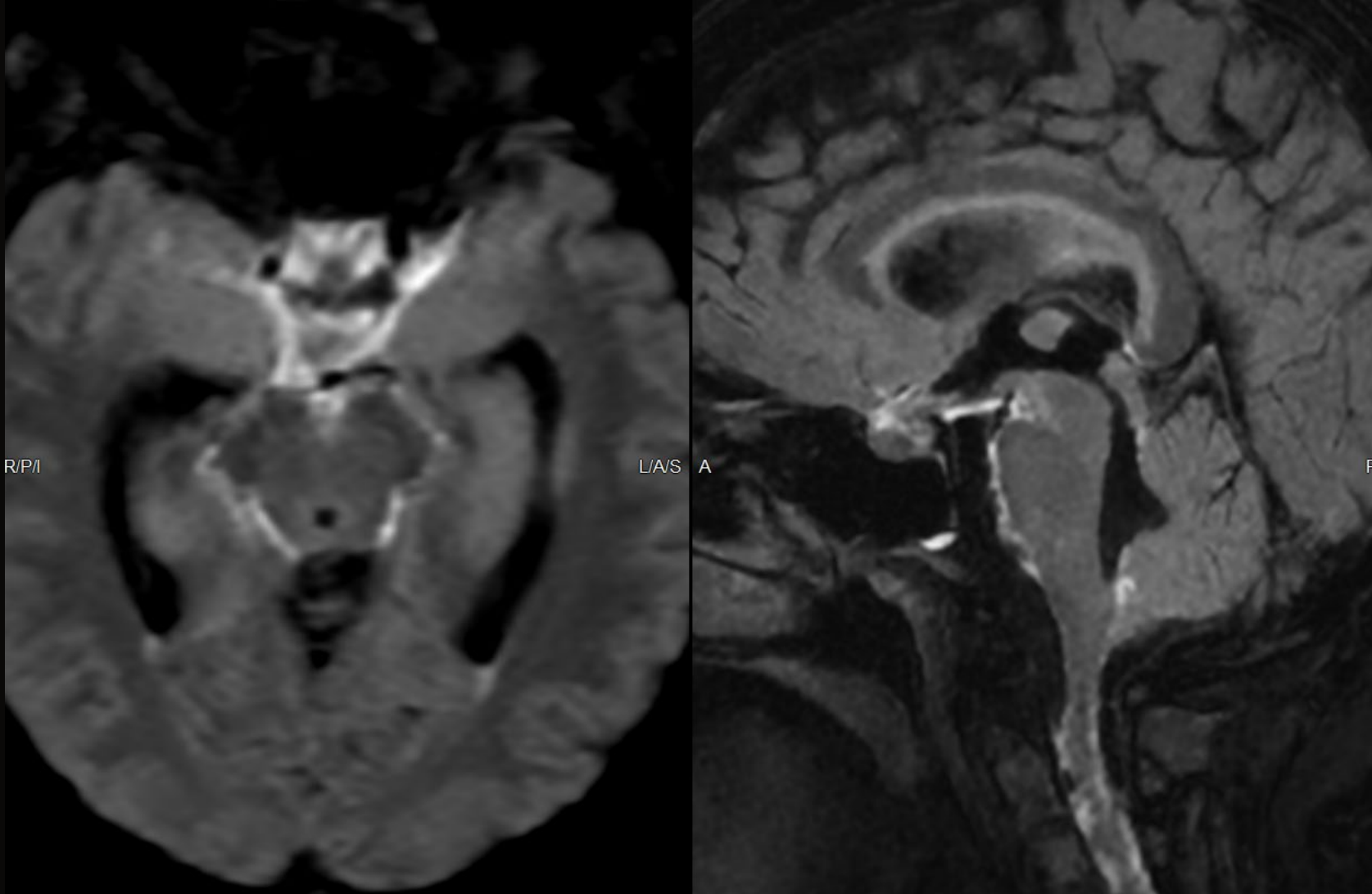
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## Leptomeningitis



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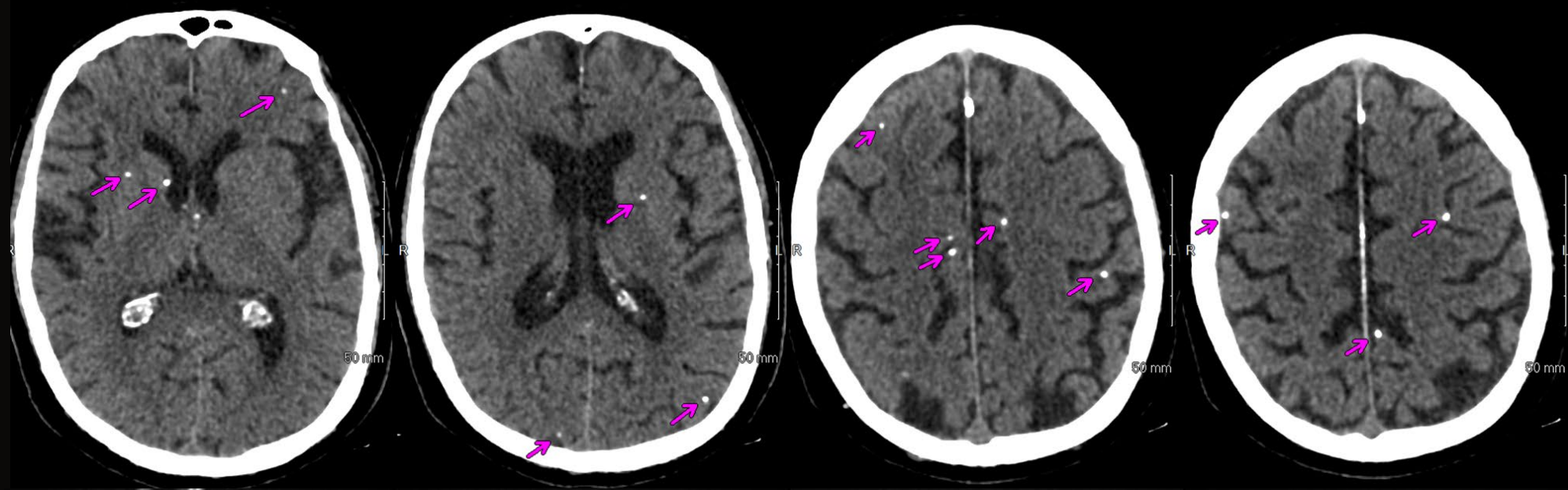
## Leptomeningitis



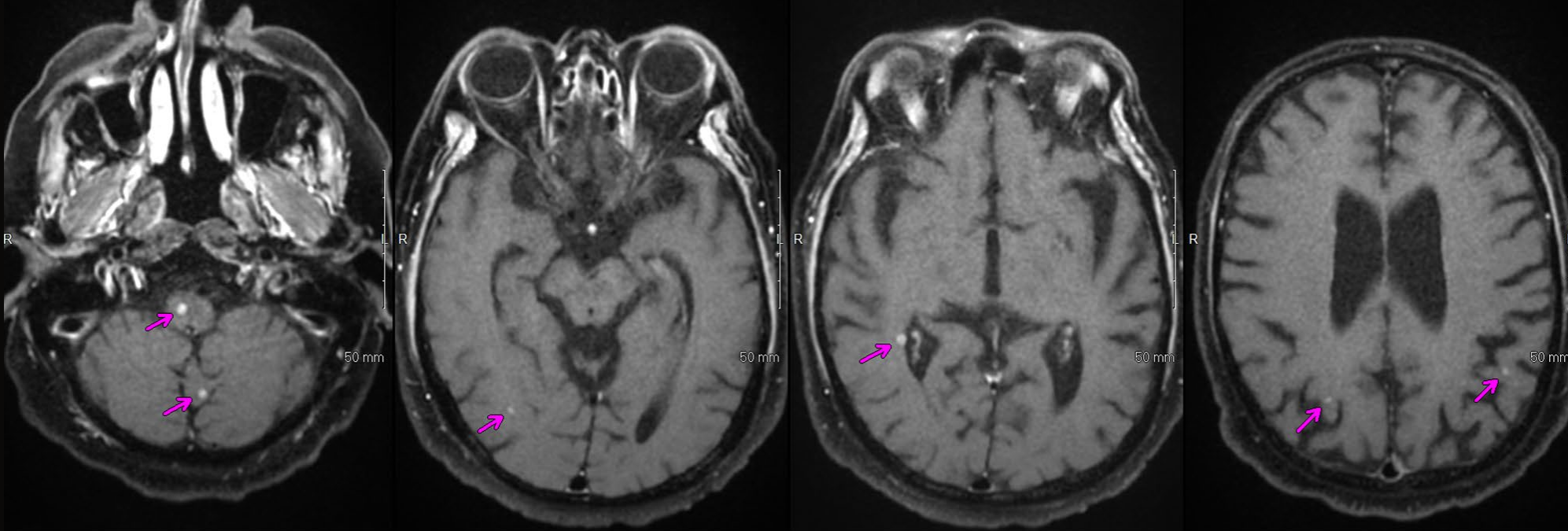
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# Case 6: 71 y/o man with disseminated TB

Tuberculomas  
(calcified)

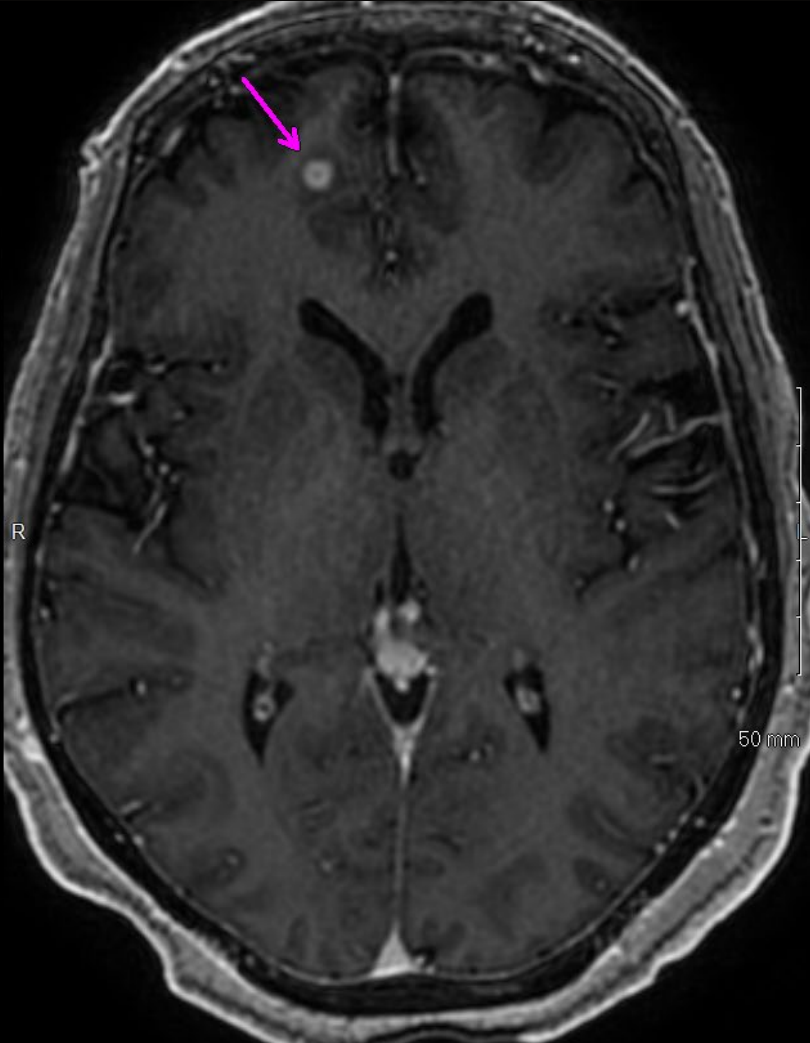
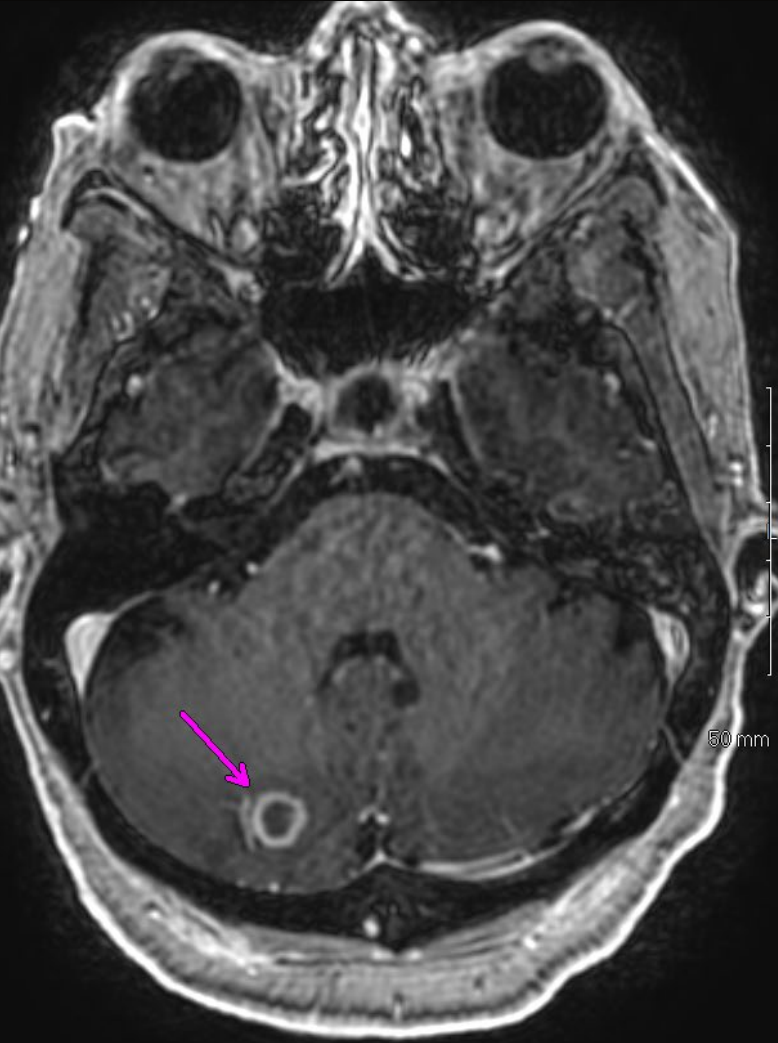


Tuberculomas  
(non-caseating)



# Case 7: 59 y/o woman from Ethiopia w/ unexpected findings during imaging workup for cholecystitis

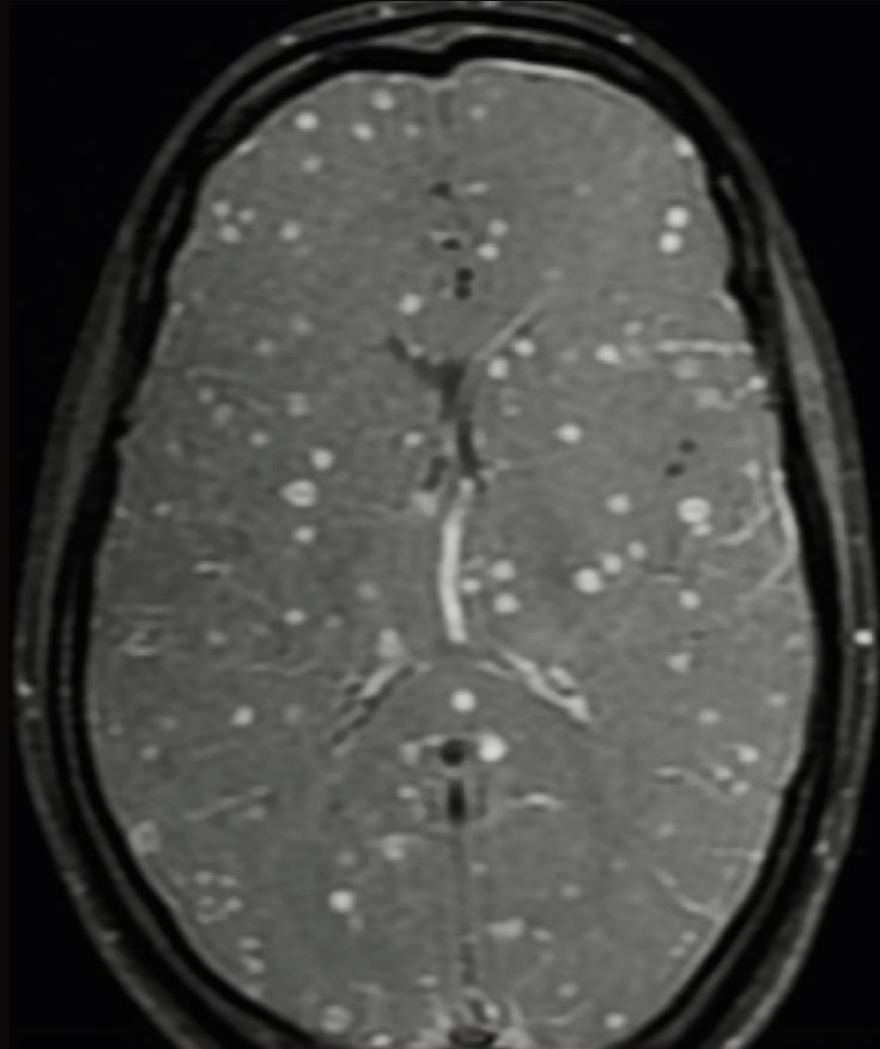
Tuberculomas (caseating)



# Parenchymal TB: Miliary Tuberculomas

- Multiple small (2-3 mm) tuberculomas disseminated in brain parenchyma
- Usually associated with TB meningitis
- Seen primarily in the immunocompromised
- Often clinically silent

# Parenchymal TB: Miliary Tuberculomas



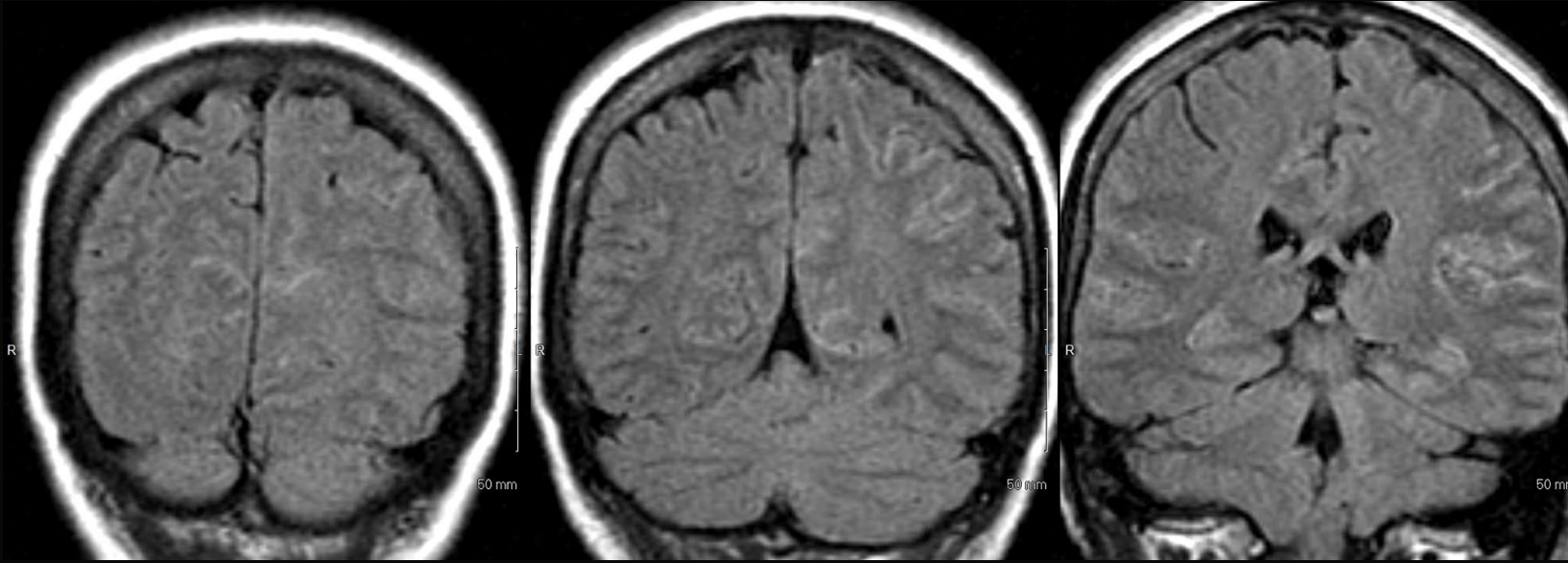
Garg RK, *Curr Opin Neurol* 2025, 38:406–413

# Parenchymal TB: Tuberculous Abscess

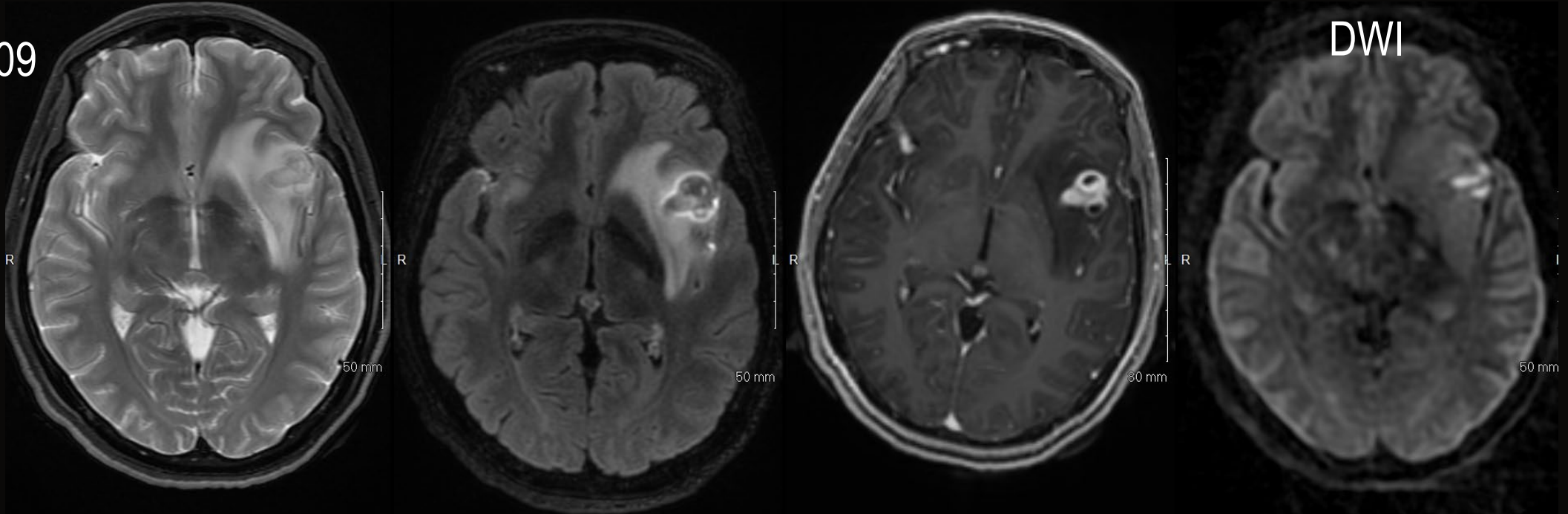
- Much less common than tuberculomas (<10% of CNS TB; 20% if TB + HIV)
- More accelerated clinical course (fever, HA, neuro signs)
- Often develops from tuberculoma but...
  - Filled with pus and teeming with tubercle bacilli
  - Walls often thicker and lack giant cell epithelioid granulomatous reaction
  - Often larger (> 5 mm) and/or multiloculated
  - May need urgent surgical drainage
- Resembles caseating tuberculoma w/ liquefaction and pyogenic / fungal abscess
- MRI: ring-enhancing, T2-hyperintense center, diffusion-restricted, edema

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OCT 2009



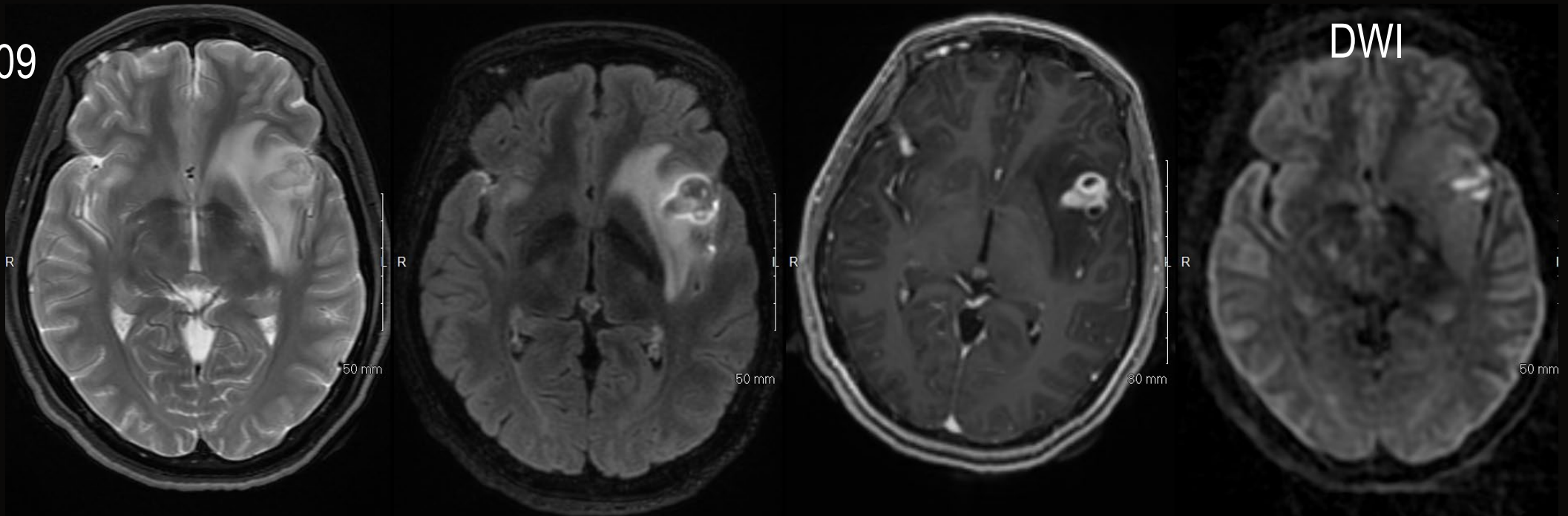
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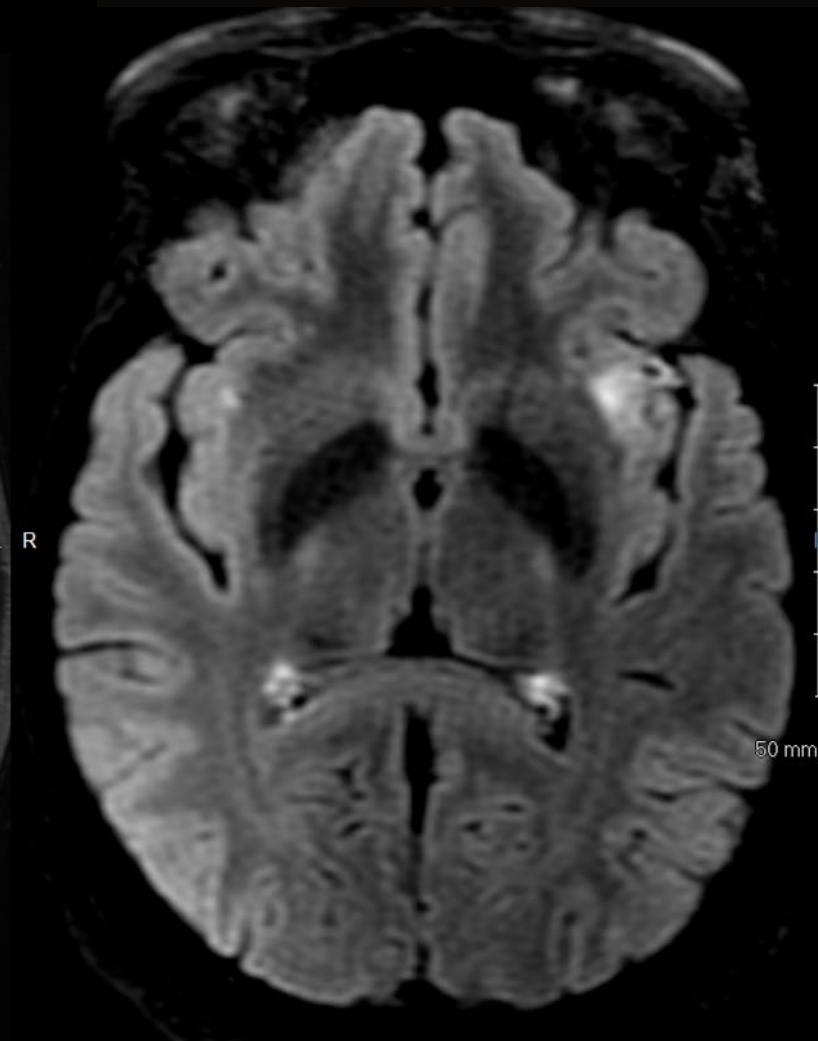
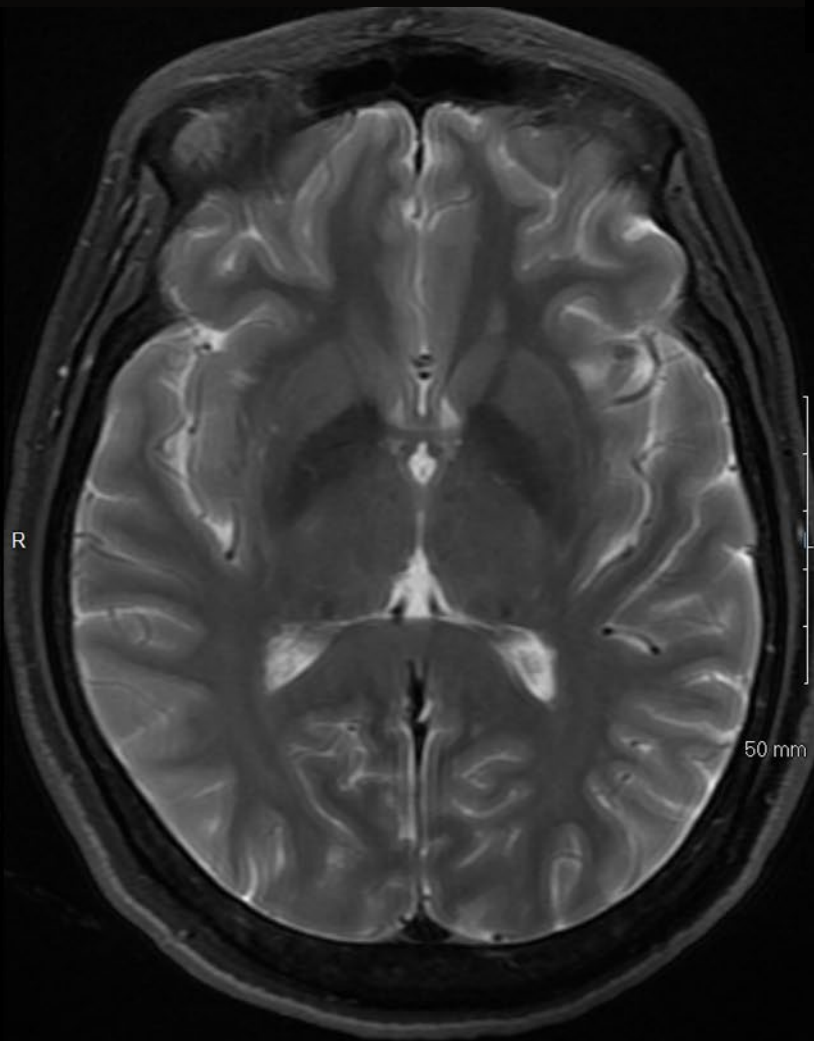
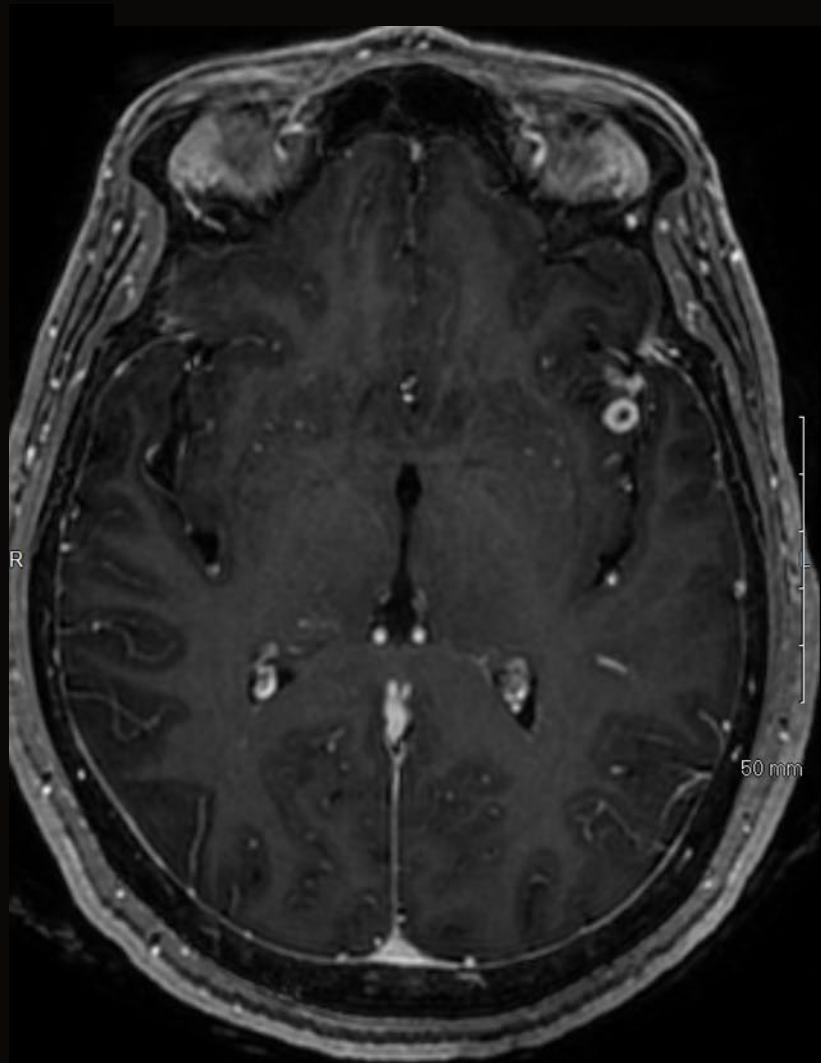
## Tuberculous Abscess

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# Case 1: 45 y/o woman w/ headache, fever, altered mental status

## Post-treatment



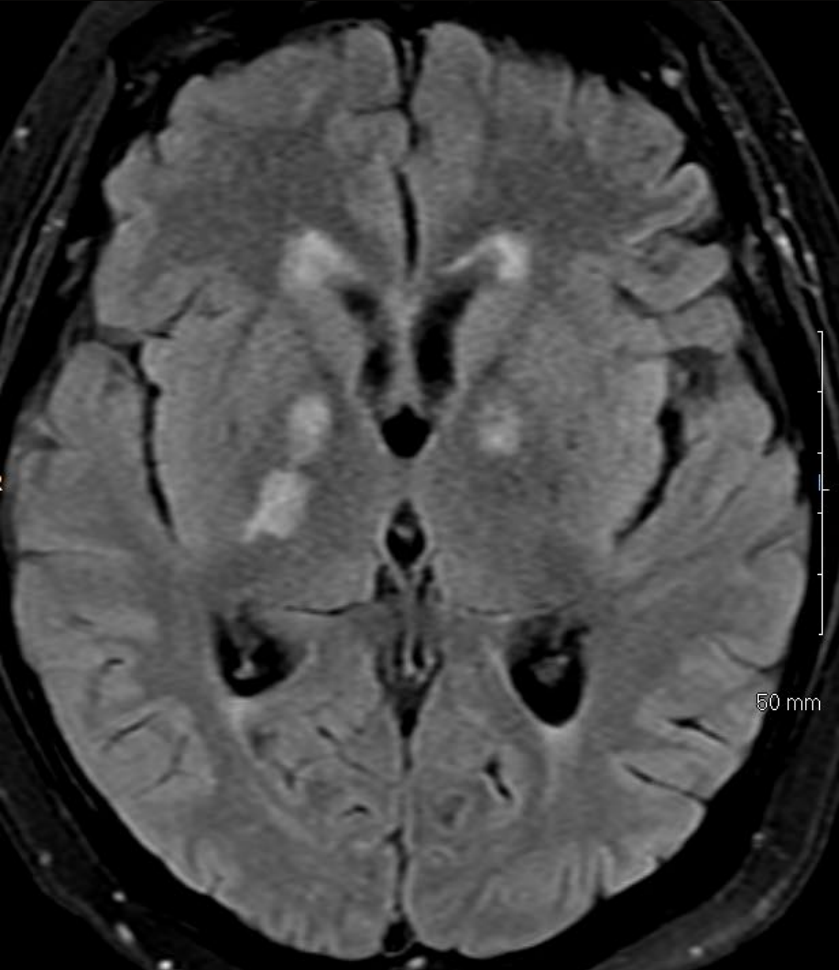
# Parenchymal TB: Tuberculous Cerebritis / Encephalopathy

- Tuberculous cerebritis
  - Localized parenchymal infection w/ microgranulation, few bacilli, no caseation
  - Usually associated with TB meningitis
  - Patchy T2/FLAIR hyperintensity, +/- enhancement
- Tuberculous encephalopathy
  - Delayed type-IV T-cell mediated hypersensitivity reaction to tuberculo-protein
  - Young children or infants w/ pulmonary TB
  - Extensive white matter injury
  - Seizures, AMS but no meningeal signs
  - May resemble ADEM
  - Poor prognosis

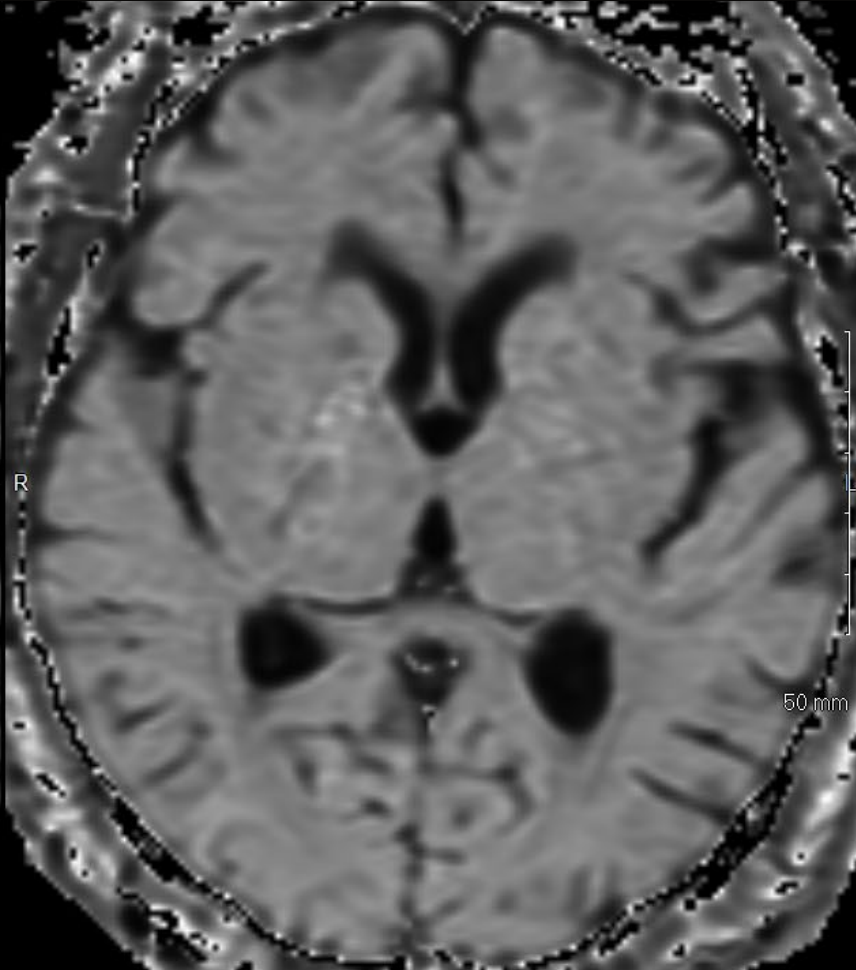
# Parenchymal TB: Tuberculous Cerebritis / Encephalopathy

Cerebritis (vs. Subacute Infarcts)

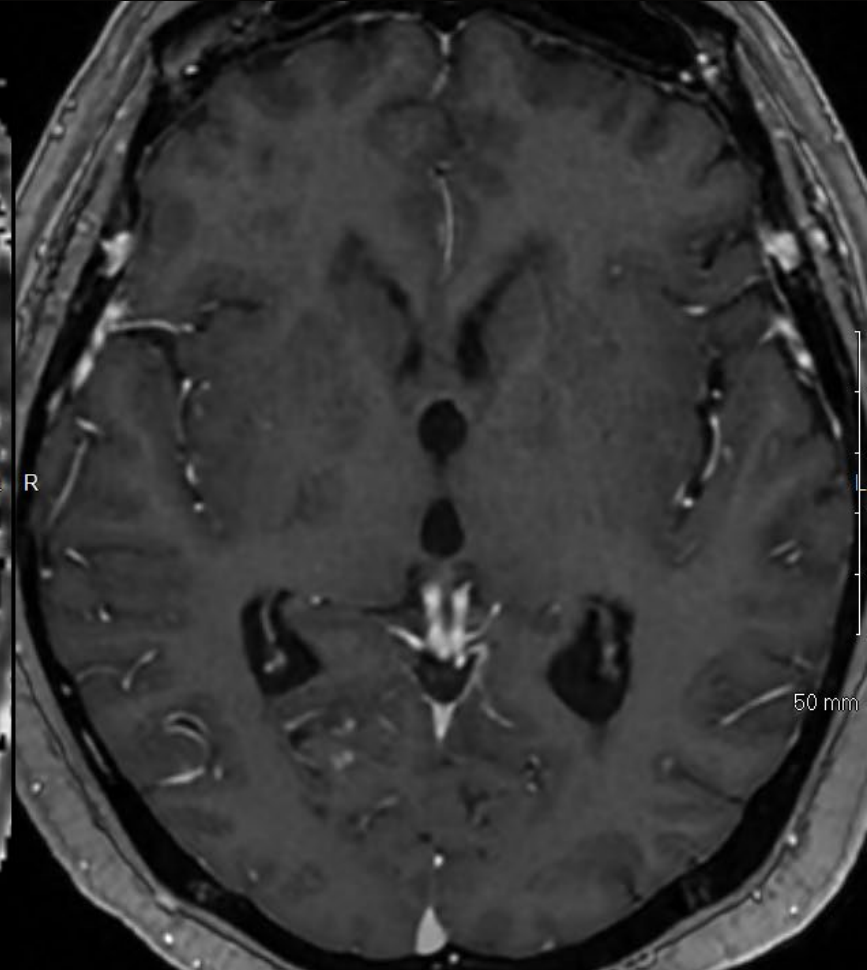
T2-FLAIR



DWI



T1+C



# Spinal TB: Tuberculous Spondylitis (Pott's Disease)

- Most common spinal TB (>60%)
- Common cause of paraplegia
- Hematogenous spread to vertebrae via Batson's plexus
- Lumbar > thoracic > cervical
- Multiple vertebrae w/ disc sparing (early) and "skip" lesions  
(c/w pyogenic spondylitis – disc usually involved, no skipping!)
- Pathologic VB fractures, vertebra plana, chronic deformity
- Paraspinal extension common
- Epidural / subdural abscess → spinal cord, nerve root compression
- May directly infect meninges, cord

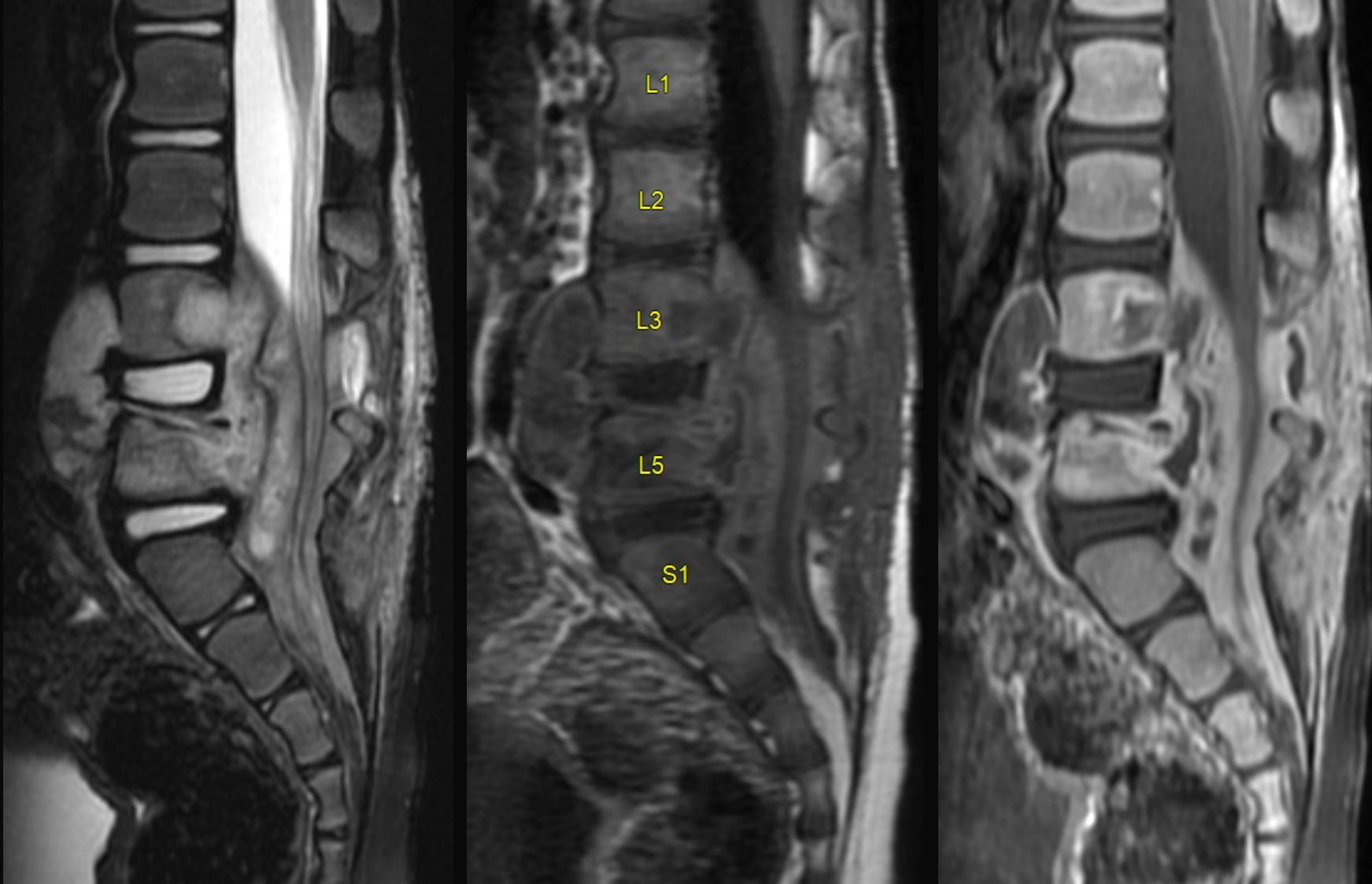
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**Tuberculous  
Spondylitis with  
Vertebra Plana**



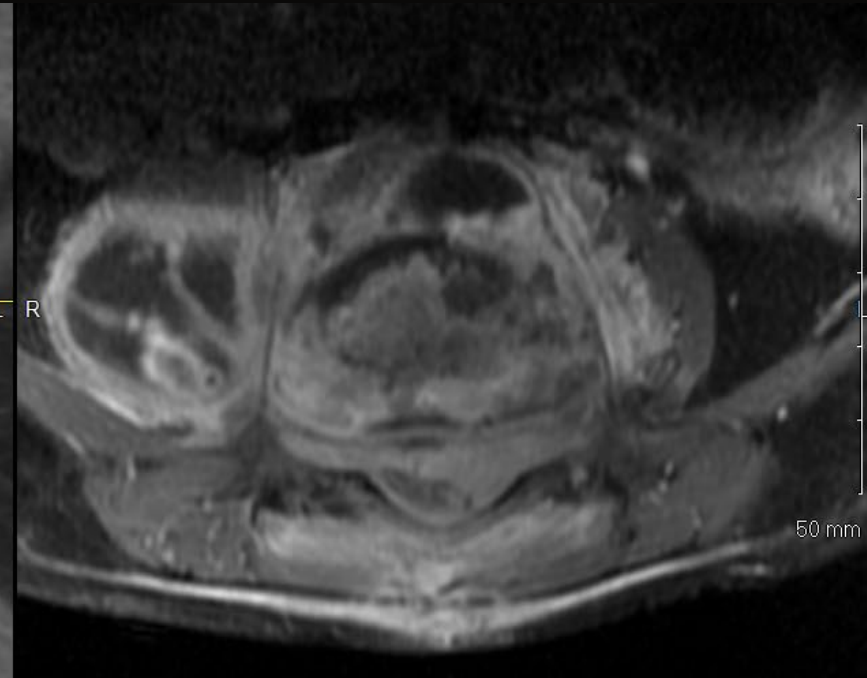
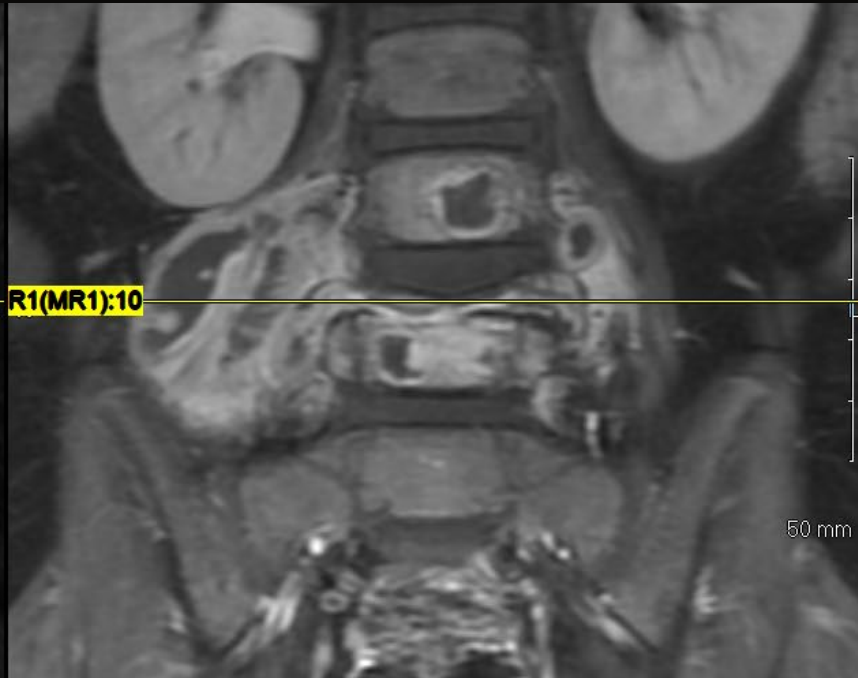
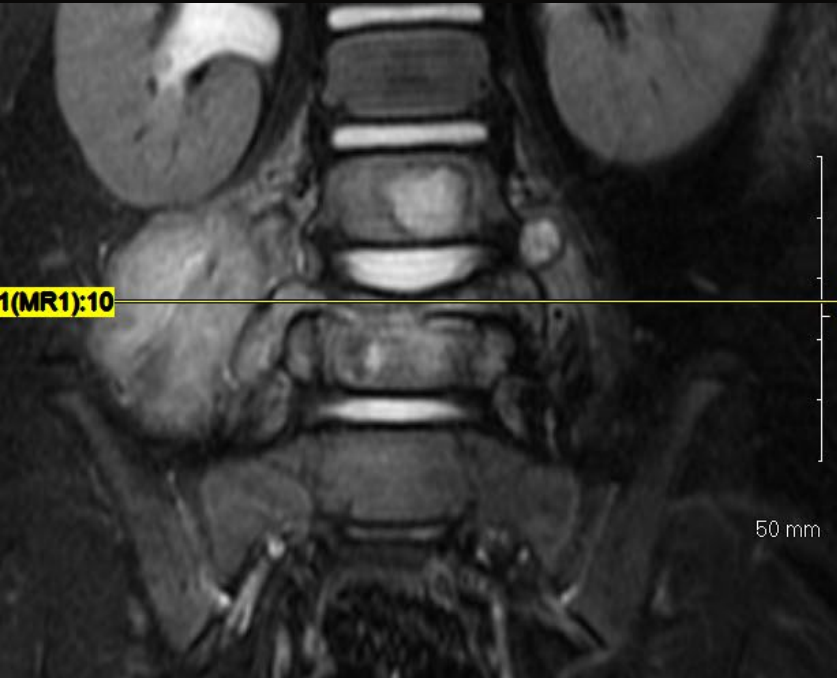
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### Tuberculous Spondylitis with Epidural Abscess and Vertebra Plana



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### Tuberculous Spondylitis with Epidural Abscess and Vertebra Plana

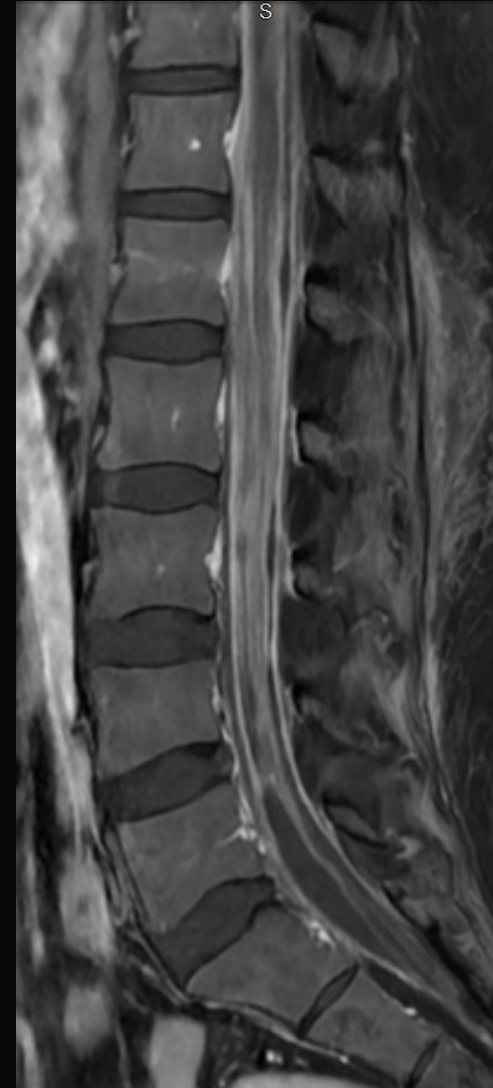
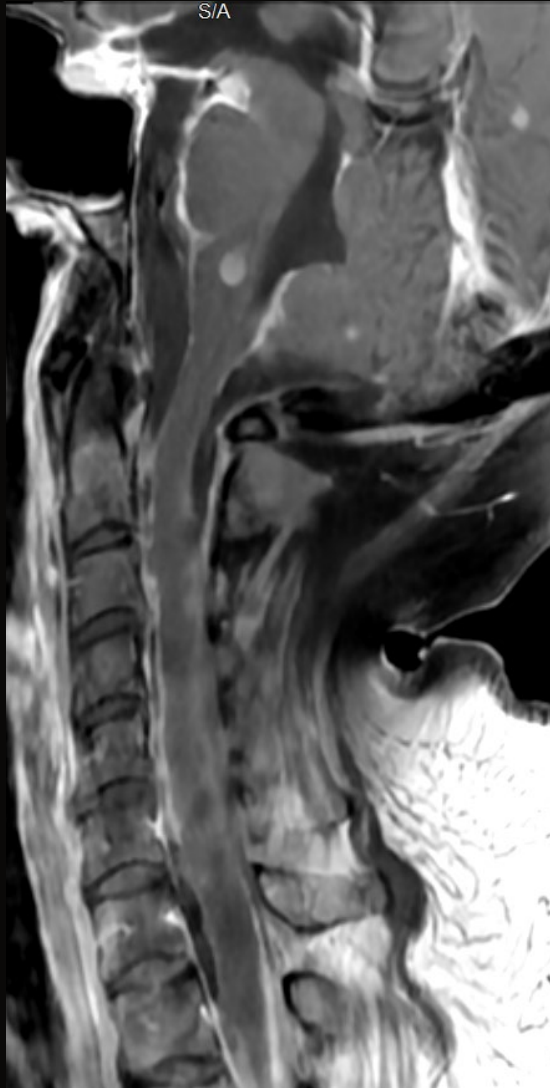


# Spinal TB: Tuberculous Meningitis, (Radiculo)myelitis, Arachnoiditis

- Subarachnoid exudates involving cord surface, cauda equina nerve roots
- Eventual matting / clumping of nerve roots, CSF loculations (arachnoiditis)
- Cord edema / ischemia (spinal arteritis) / syringomyelia
- Myelitis more commonly cervical

# Case 9: 43 y/o woman with fever, LE weakness, AMS, hyponatremia

## Tuberculous Meningitis, Radiculomyelitis



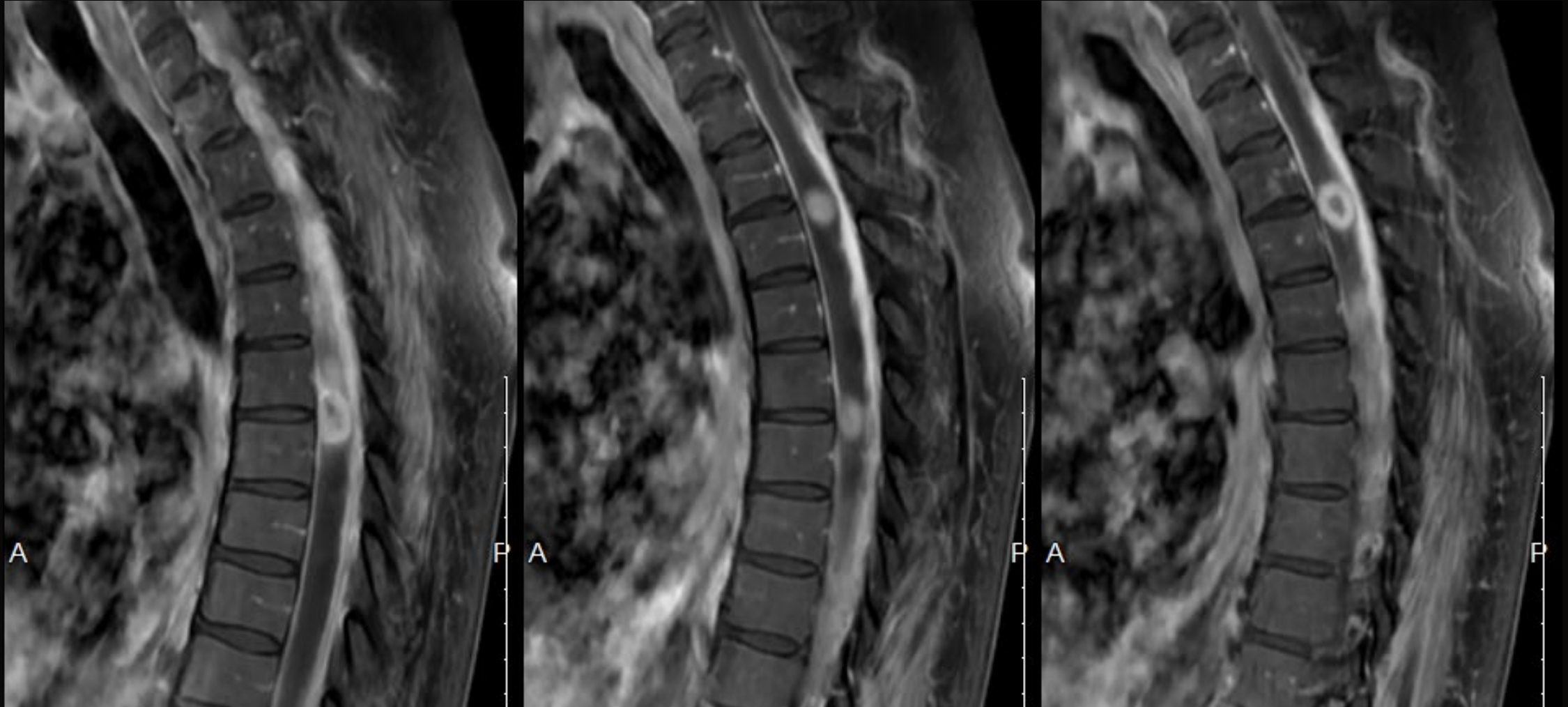
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# Spinal TB: Spinal Cord Tuberculoma, Abscess

- Rare (2% CNS TB, 2:100,000 all TB)
- Intramedullary (within cord parenchyma) tuberculoma / abscess
- Imaging features as in brain

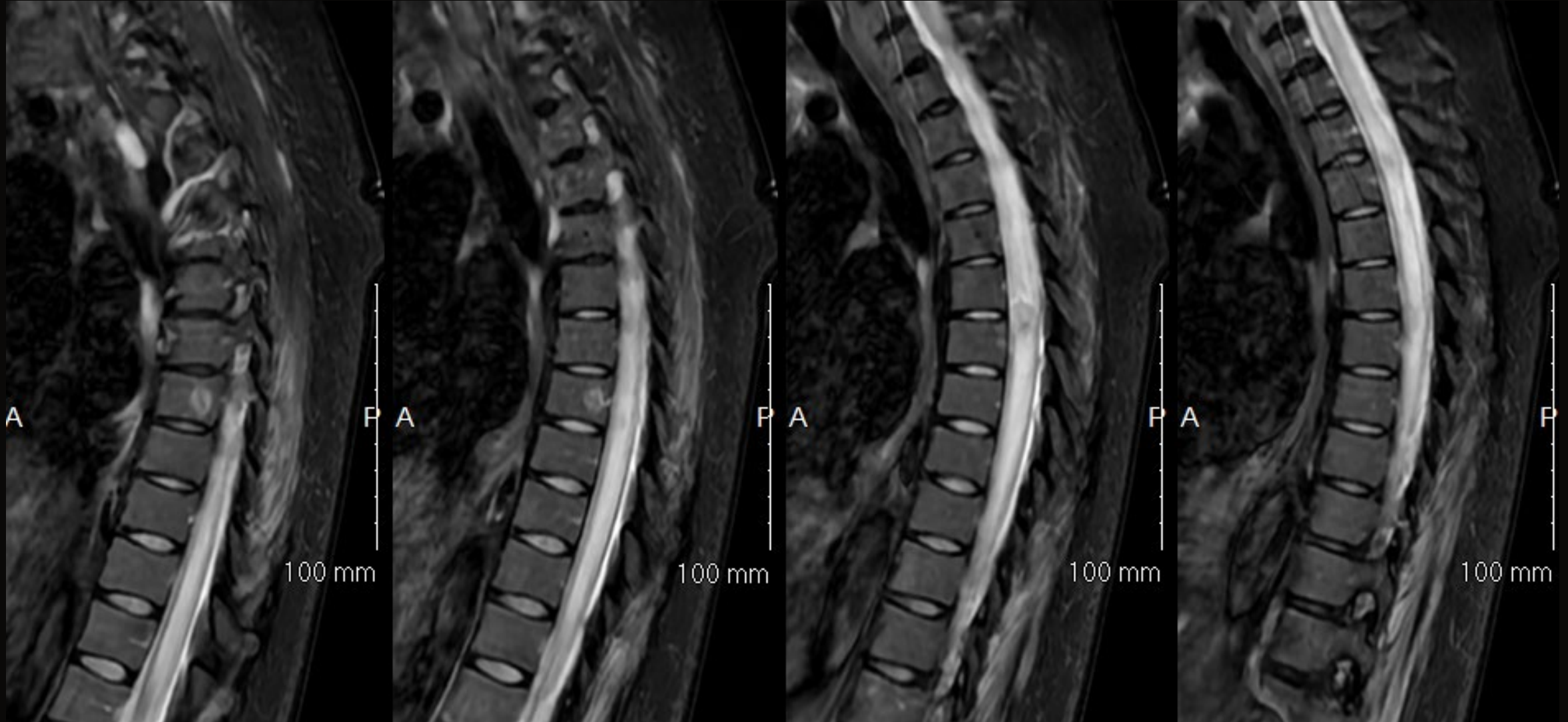
# Case 9: 43 y/o woman with fever, LE weakness, AMS, hyponatremia

Tuberculous Meningitis, Myelitis, Cord Tuberculomas



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Tuberculous Meningitis, Myelitis, Cord Tuberculomas



# Differential Diagnosis

- Other infections: bacterial, fungal, parasitic (e.g. toxoplasmosis, cysticercosis)
- Other granulomatous: neurosarcoidosis
- Histiocytic: Langerhans Cell Histiocytosis (LCH)
- Neoplastic:
  - Leptomeningeal: carcinomatosis, lymphomatosis
  - Pachymeningeal: meningioma
  - Parenchymal: metastasis, glioma, lymphoma

## CNS TB most commonly presents as...



A	Leptomeningitis
B	Pachymeningitis
C	Tuberculoma
D	Tuberculous abscess

## Spinal TB most commonly presents as...

A	Meningitis
B	(Radiculo)myelitis
C	Spondylitis
D	Arachnoiditis



# Spectrum of CNS Tuberculosis

- Meningeal TB

- Leptomeningitis (most common of all)
- Pachymeningitis (TB of the dura)

- Parenchymal TB

- Tuberculous granuloma (tuberculoma)
- Miliary tuberculomas
- Tuberculous abscess
- Tuberculous cerebritis
- Tuberculous encephalopathy

- Spinal TB

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- Miscellaneous

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20% of TB cases in immunocompromised

# References

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