Imaging in headache

Pitfalls for a Neurologist

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Imaging in Migraine
Why different?

Migraine is a common cause for imaging.

- The imaging findings can be **Unrelated to headache BUT Concerning**.
- The imaging findings can be **Related to headache but Non-concerning**.
- The findings can be **Related to headache AND Concerning**.

Some questions that we might encounter in headache practice

- White matter lesions in migraine like headache. Should it change my assessment and treatment plan?
- A patient with recent-onset headache and demyelinating lesions on MRI. Is it MS or RIS?
- A patient with acute to subacute headache and absent venous sinus. Is it really CVT or just a congenital hypoplasia?
- A patient with headache and papilledema. To what extent should I investigate imaging to reach the diagnosis of IIH?
- A patient with recent-onset headache and arachnoid cyst. Is it a secondary headache?
- A patient with chronic HA and compensated hydrocephalus. What to do?
- A patient with HA and lepto/pachymeningeal enhancement. What is the message?
- A patient with recent onset HA and multiple white/grey matter brain lesions. could it be CNS vasculitis?
- A patient with HA and unusual MRI finding. Is it incidental?
- Should I trust on routine MRI sequences in my patient? When does especial MRI sequences such as GRE might add something?
- What are characteristic image signs that guide me to the diagnosis?
- A patient with HA and normal MRI. Could it be still due to a serious cause?

1

A patient with typical migraine headache who unexpectedly shows remarkable brain white matter lesions

Brain white matter spots on MRI in patients with migraine

- Present in about 40% of patients with migraine.
- A topic of much debate.
- Lobar (frontal>parietal) >> BG, PV, infratentorial.
- Tend to be punctate (<3 mm diameter) and NOT confluent
- Hyperintense on flair/T2, but NOT hypointense on T1.

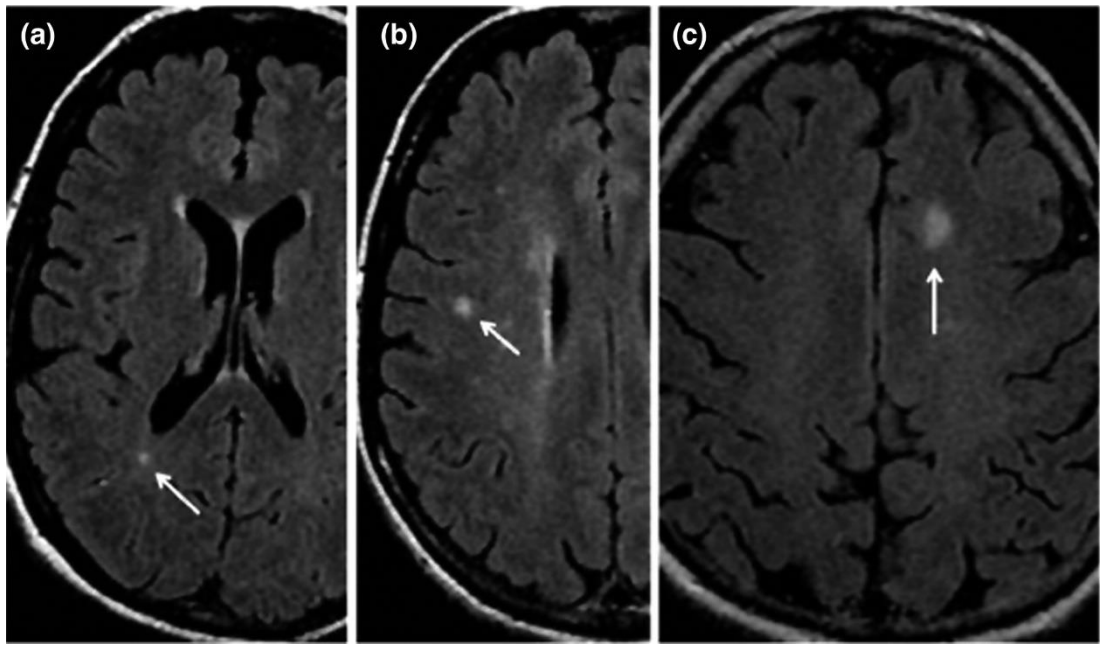
What are the risk factors associated with white matter lesions in migraine patients?

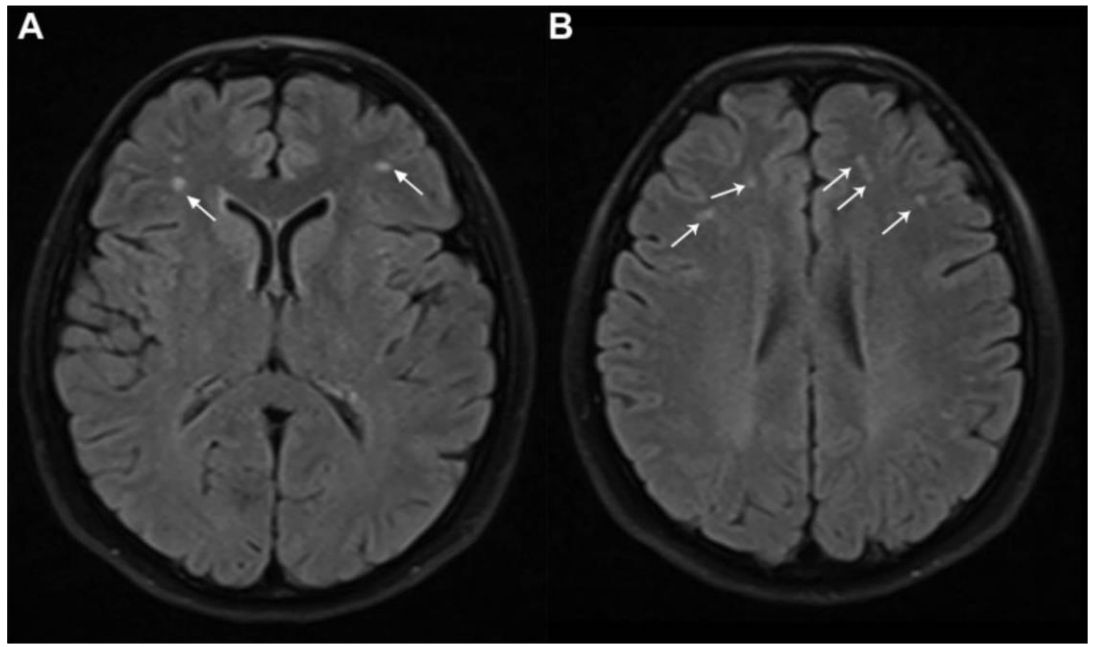
Debating results in different studies

- **Older age**
- **The presence of Vascular risk factors/Increased homocysteine**
- The presence of aura?
- Chronic migraine?
- Duration of disease?
- Frequency of attacks?
- Severity of attacks?
- Right to left shunt?

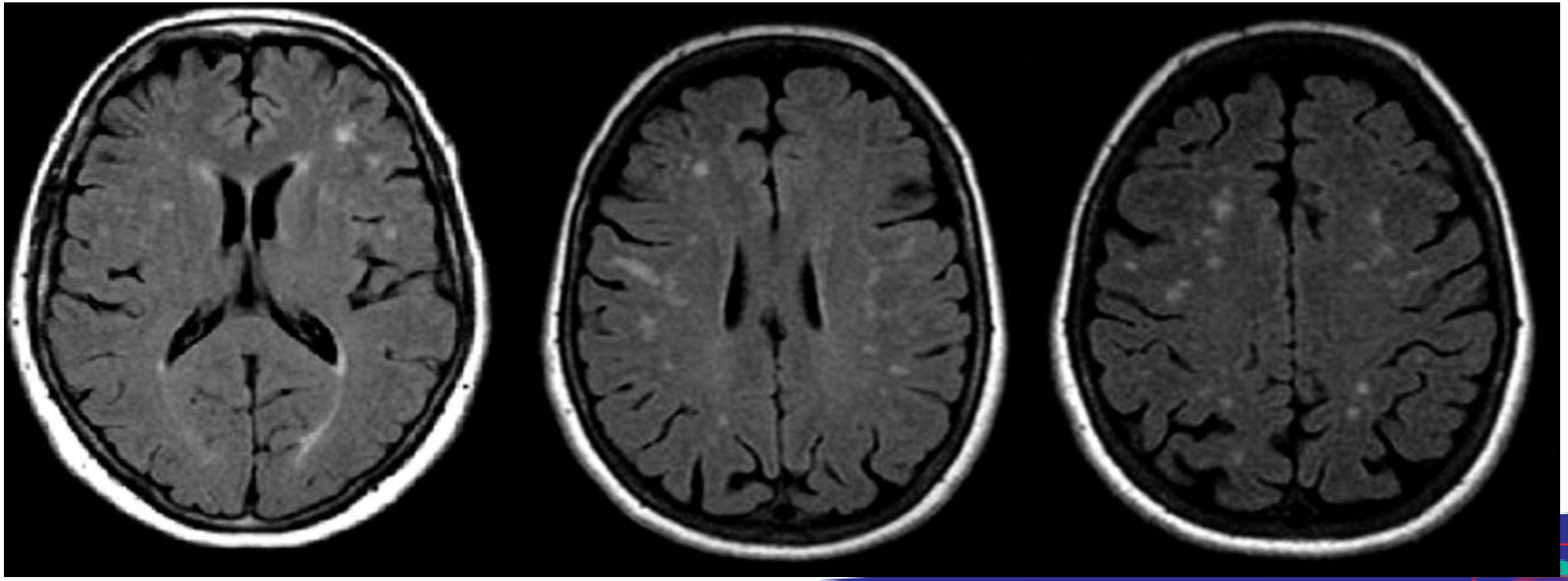
A young patient with migraine (episodic or chronic) and Minimal white dots in brain MRI.

Does it change your concern?



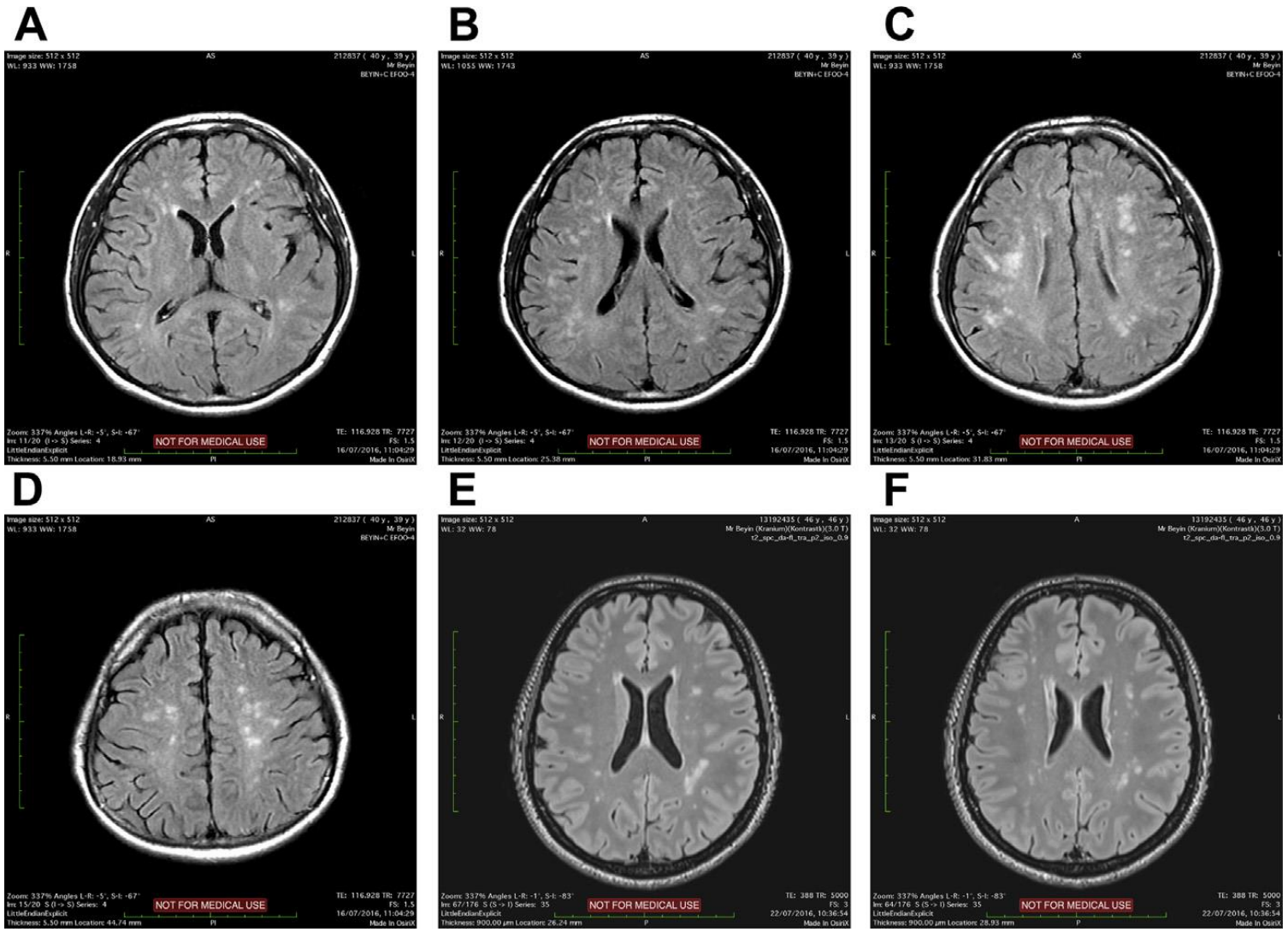


- A 43-year-old woman with **episodic migraine from 20 years ago**.
- Experiencing **visual aura** almost 2-3 times in a year.
- No vascular risk factors.
- Negative family history for Neuro/Systemic disease.
- **How would you proceed?**



A patient with migraine headache and remarkable white matter lesions on MRI.
How might it change our practice?

- Extensive search for vascular risk factors including homocysteine level.
- Consider PFO and right-left shunt in especial patients.
- Consider genetic vasculopathies in especial patients with classic migraine
- Encourage the patient that preventive Tx is likely to prevent from increasing lesions over time.
- Educate patient to avoid Triptans, Midrin, Excedrin.
- Prefer to use CCB/Beta blockers as preventive Tx.
- Preferentially avoid Venlafaxine and CGRP antagonists.
- Better to avoid Estrogen supplementation.
- Monitor the patient with serial MRI as your judgment.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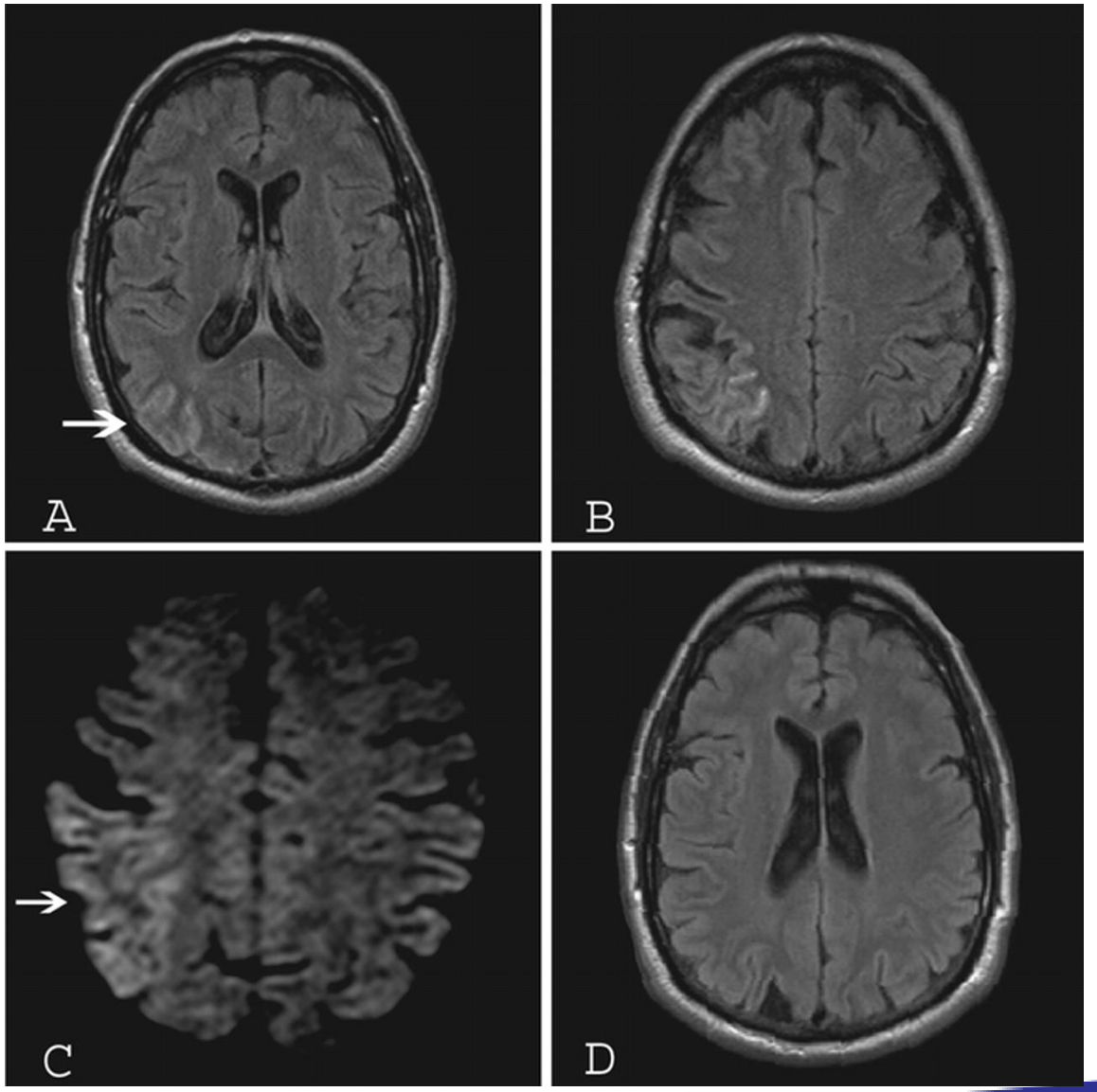
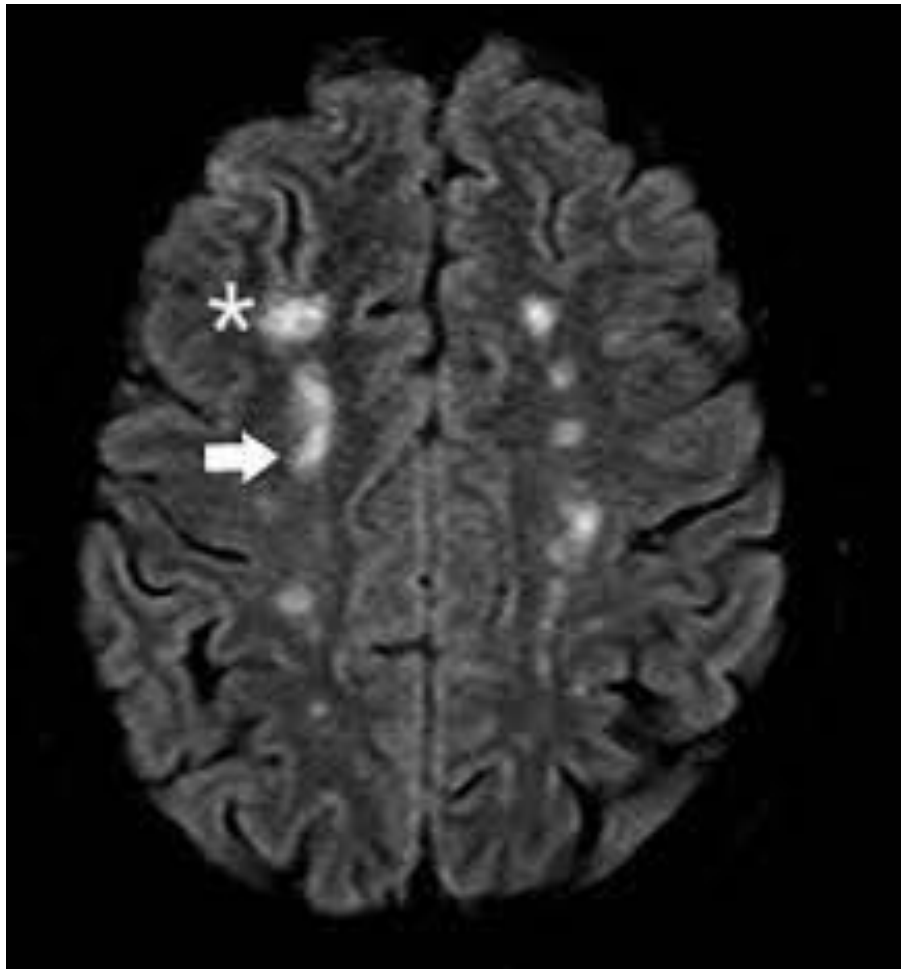
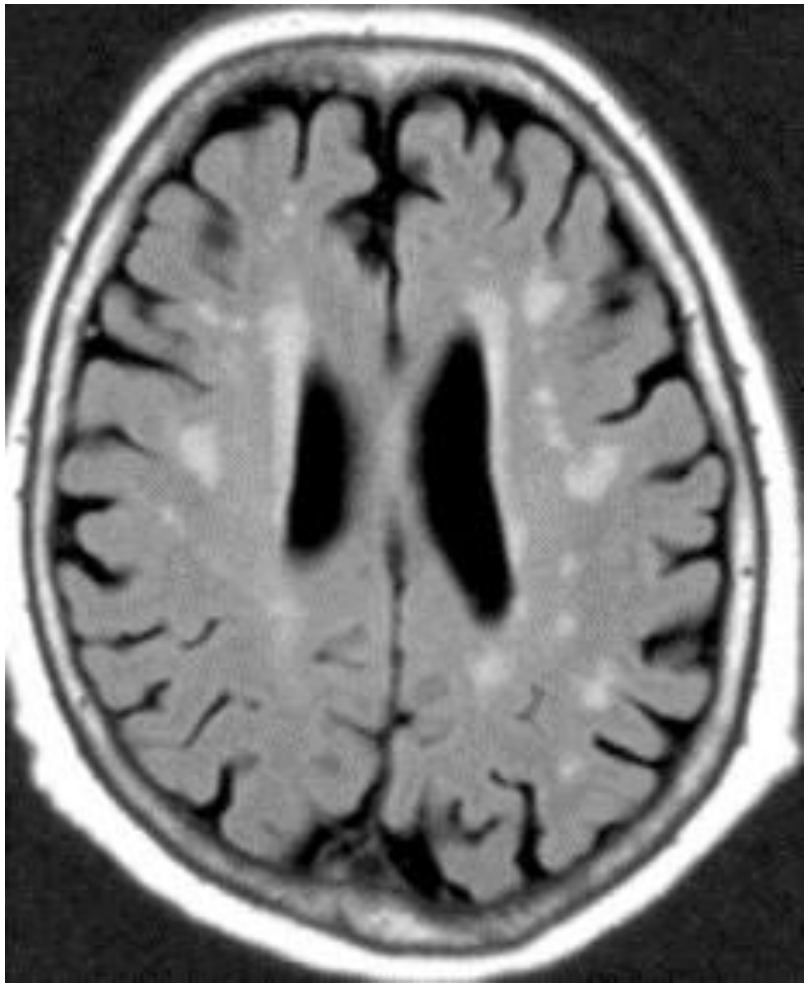
NOT FOR MEDICAL USE

- **A 40-year-old man with migraine with aura**.
- MRI reveals bilateral mostly subcortical semi-symmetrical NSWMAs in an umbrellalike distribution!
- Echocardiography discloses a large PFO and an embolic shower test that was positive.

- A 42-year-old woman with attacks of migraine with visual aura.
- Large PFO with right-left shunt was disclosed?!



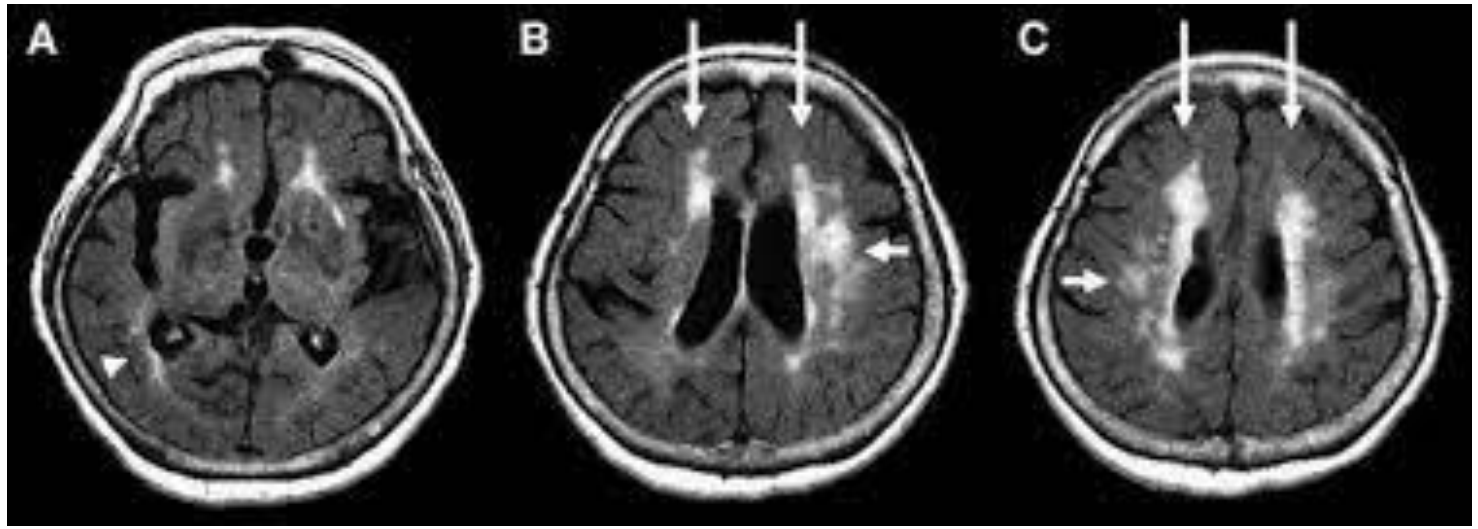


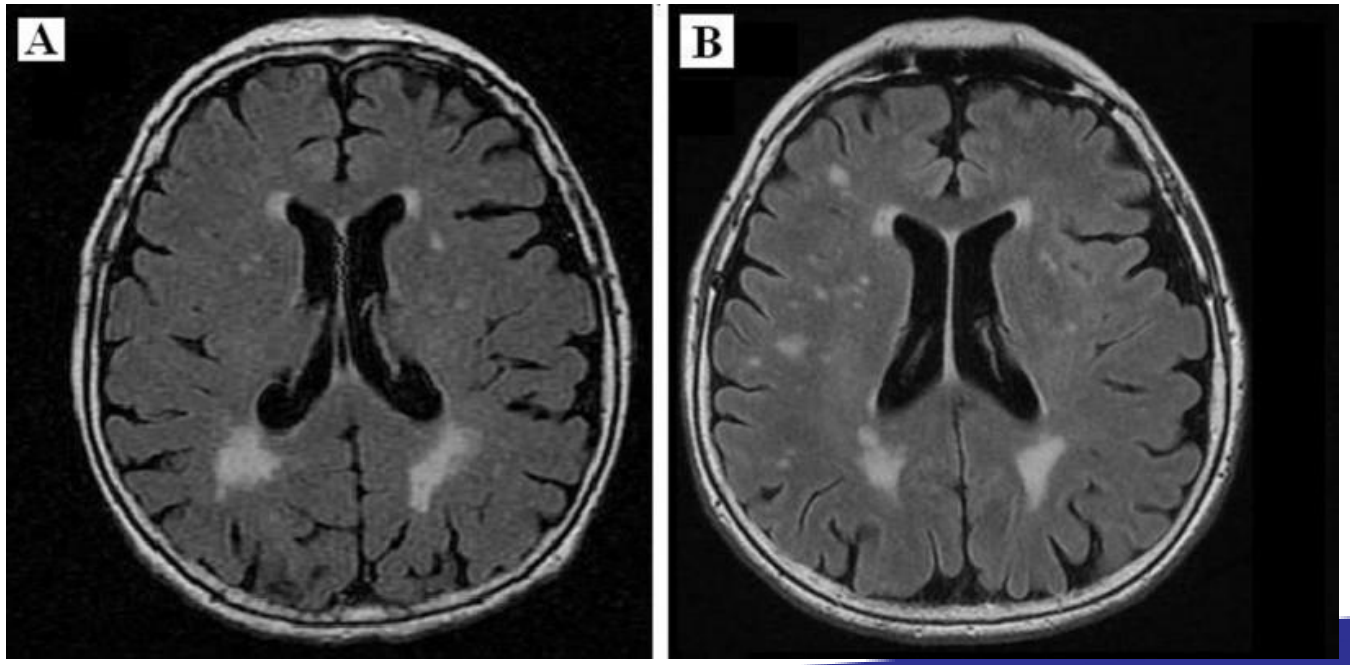


When to suspect PFO in a patient with migraine?

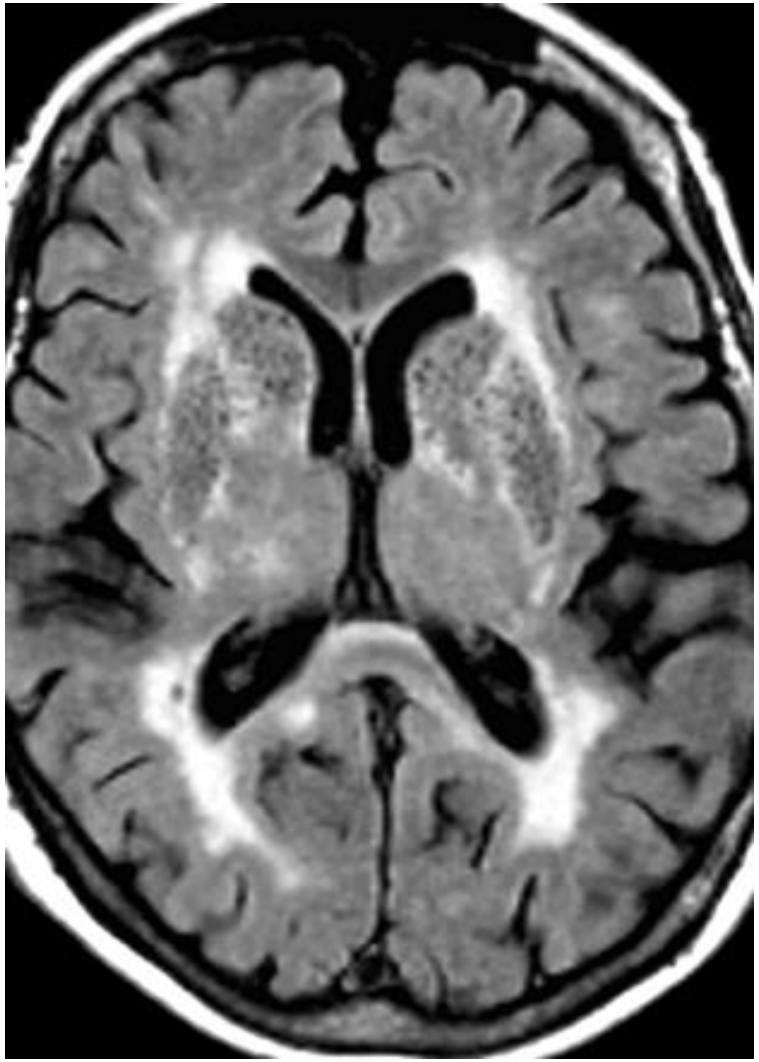
- Migraine and unexplained stroke like episodes.
- Migraine with aura AND Occipital lesions.
- Widespread unilateral or bilateral white matter lesions/Bilateral JC brain lesions?

- Consider increased Homocysteine as a risk factor for cerebral SVD.
- Migraine could be an epiphenomenon.

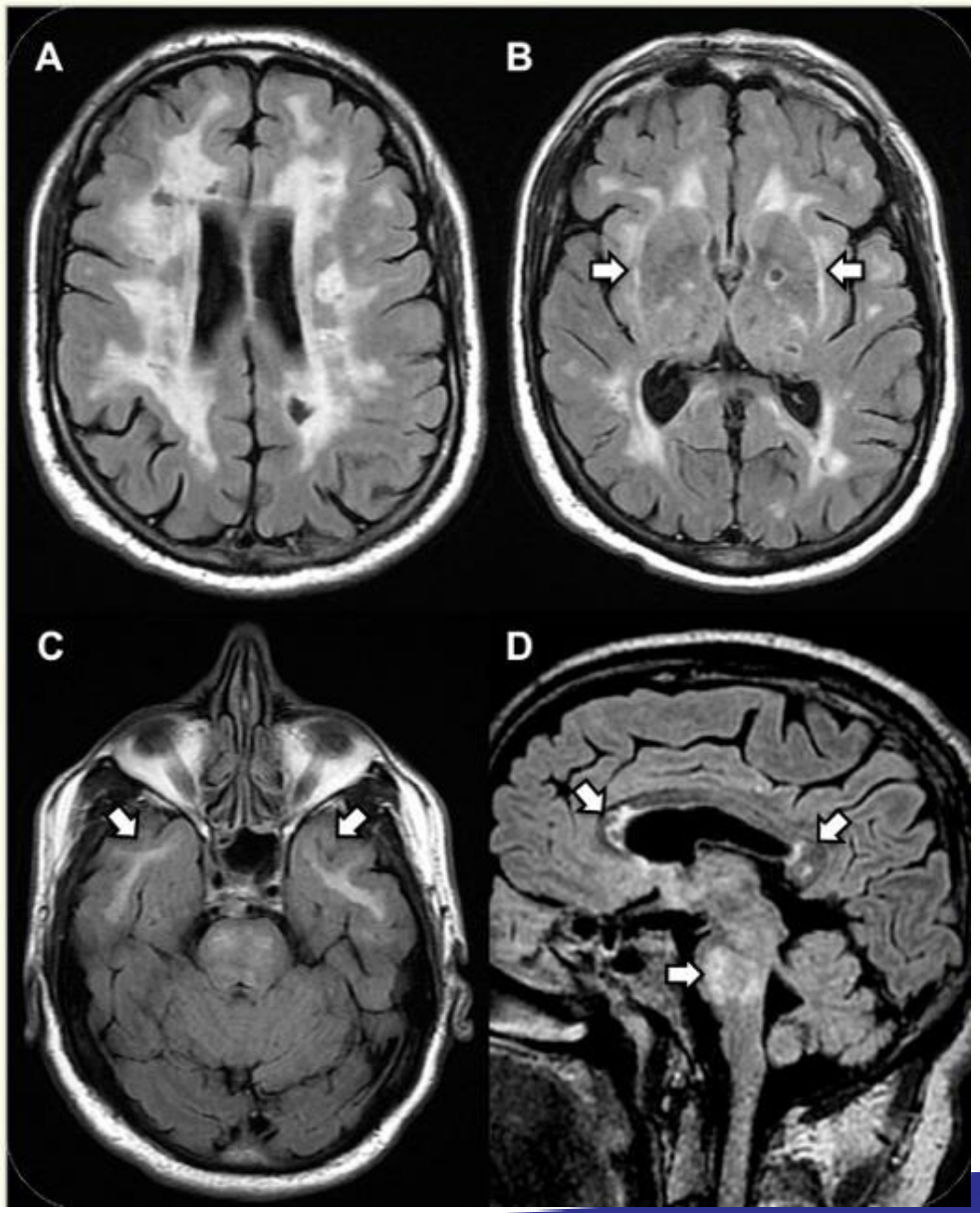


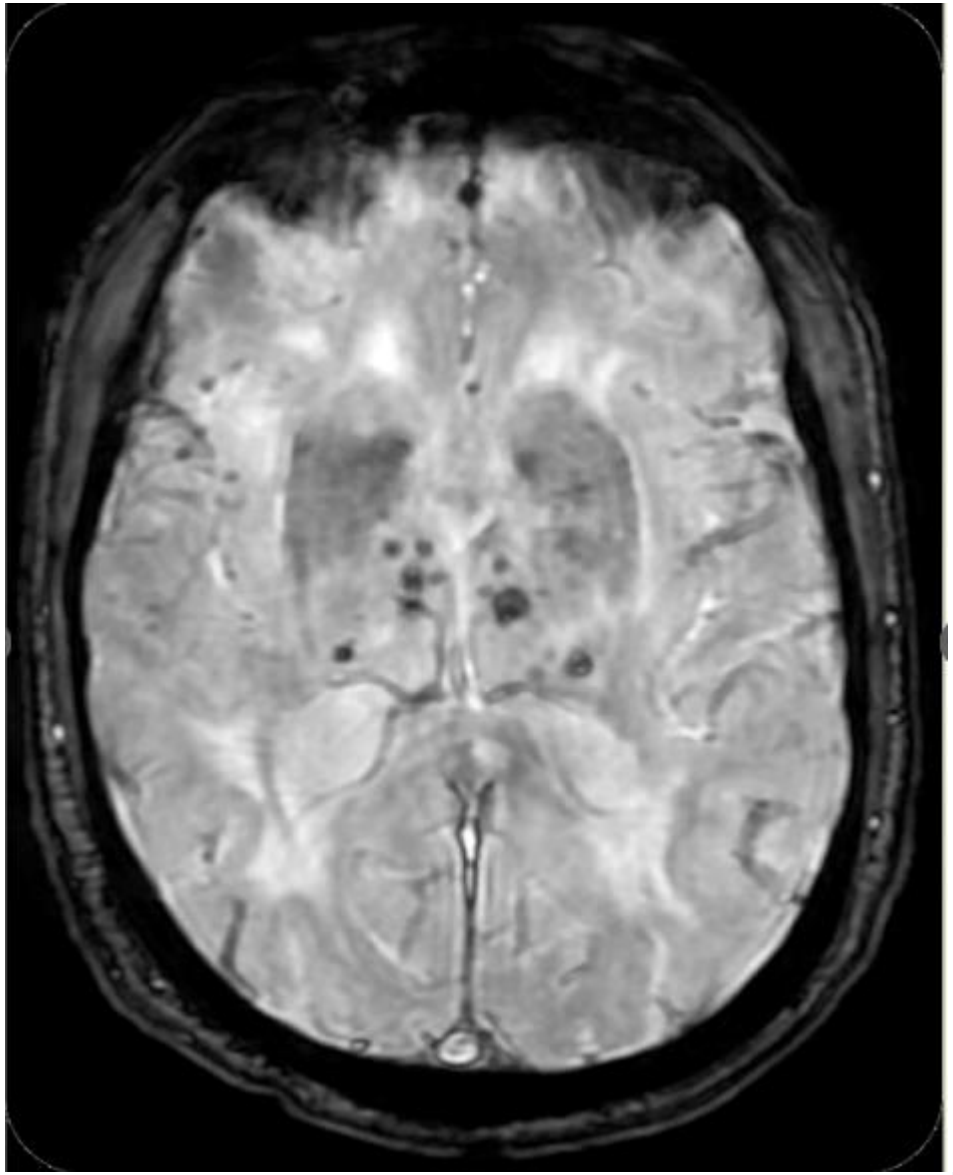


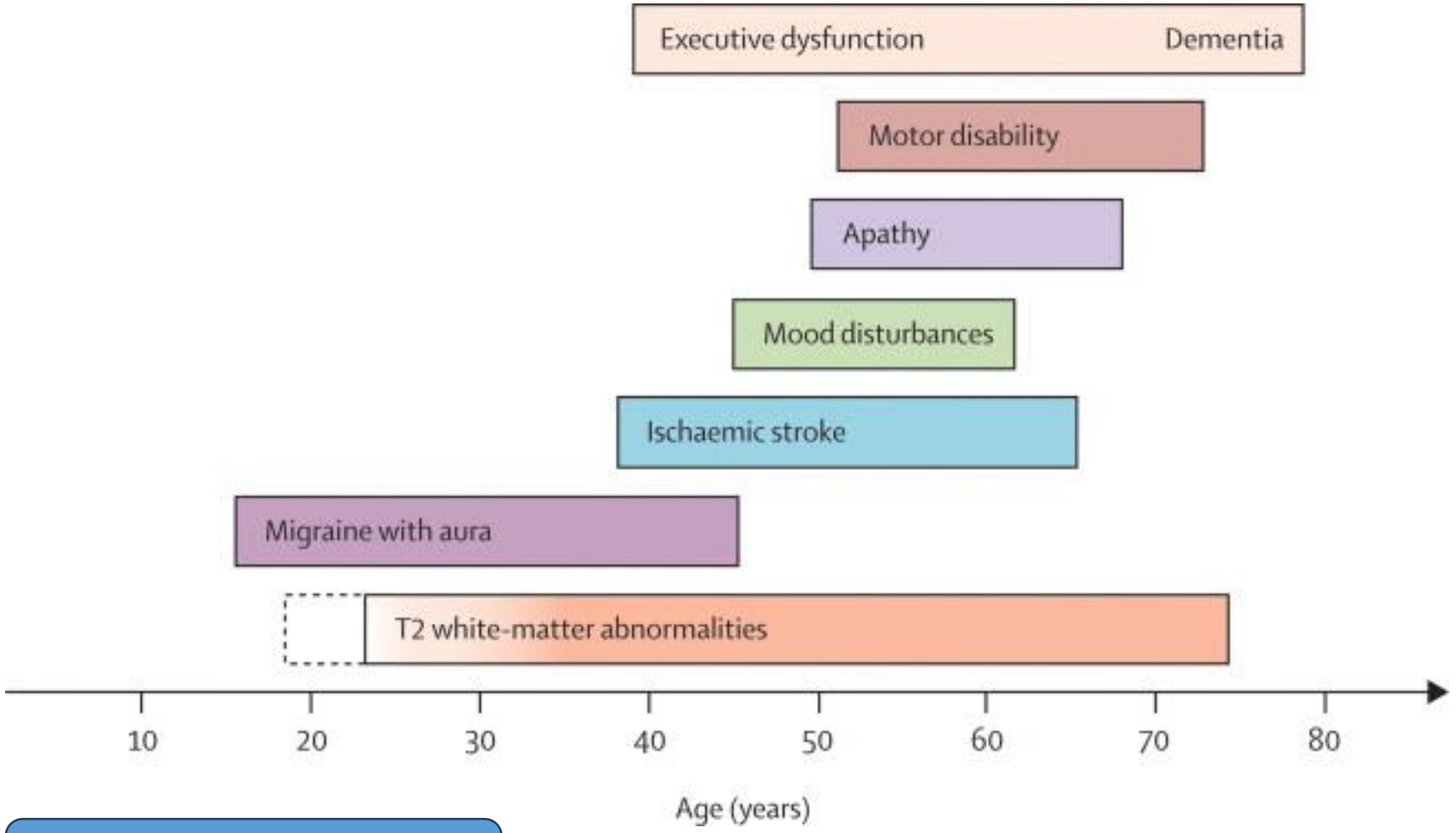
A 46-year old man with chronic migraine



- A 58 year old man with **H/O migraine from about 10 years ago**.
- **Behavioral changes (apathy) and progressive forgetfulness** from two years ago.
- H/O smoking.
- Previously diagnosed as atherosclerotic cerebral SVD.

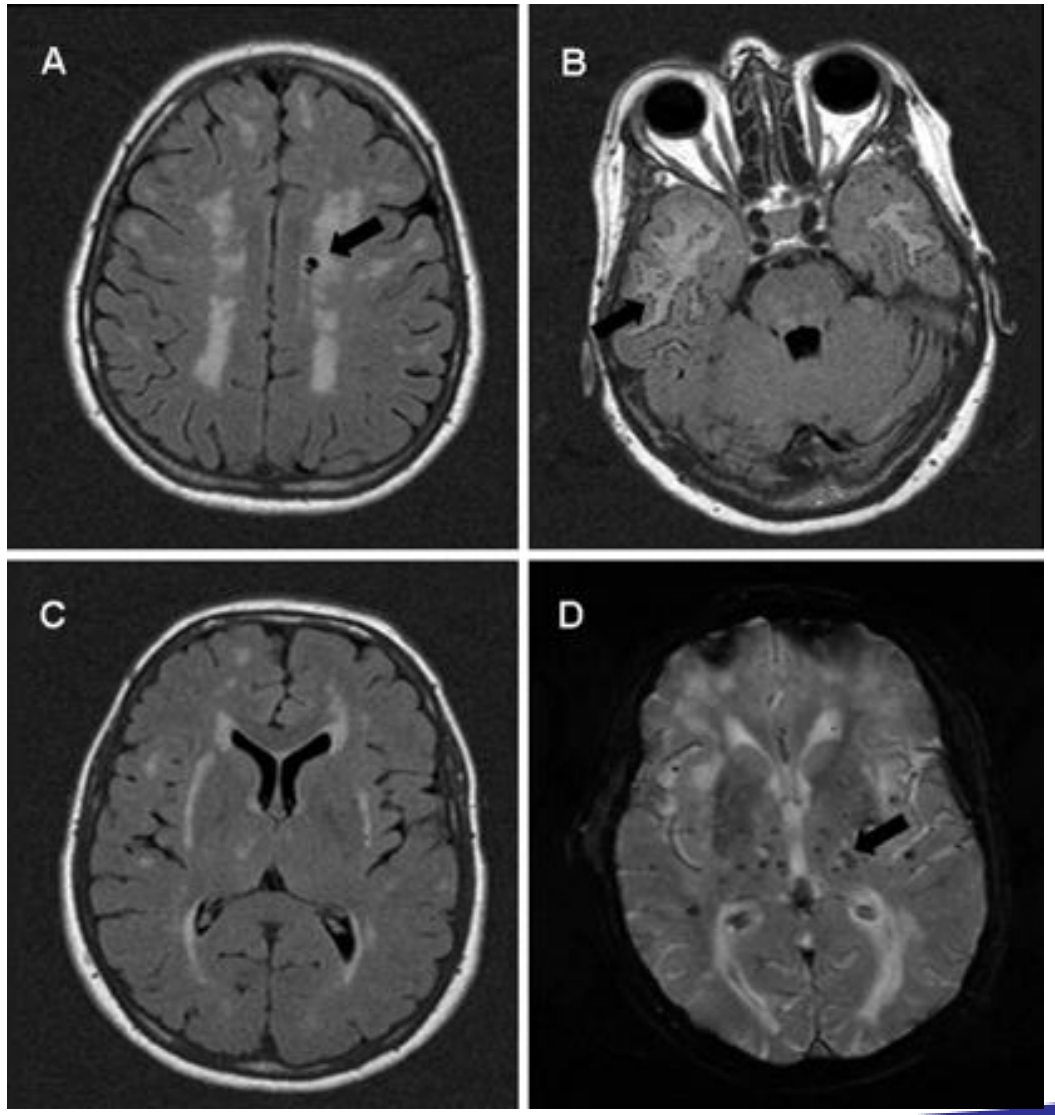





Executive dysfunction
Dementia
Motor disability
Apathy
Mood disturbances
Ischaemic stroke
Migraine with aura
T2 white-matter abnormalities
10
20
30
40
50
60
70
80
Age (years)

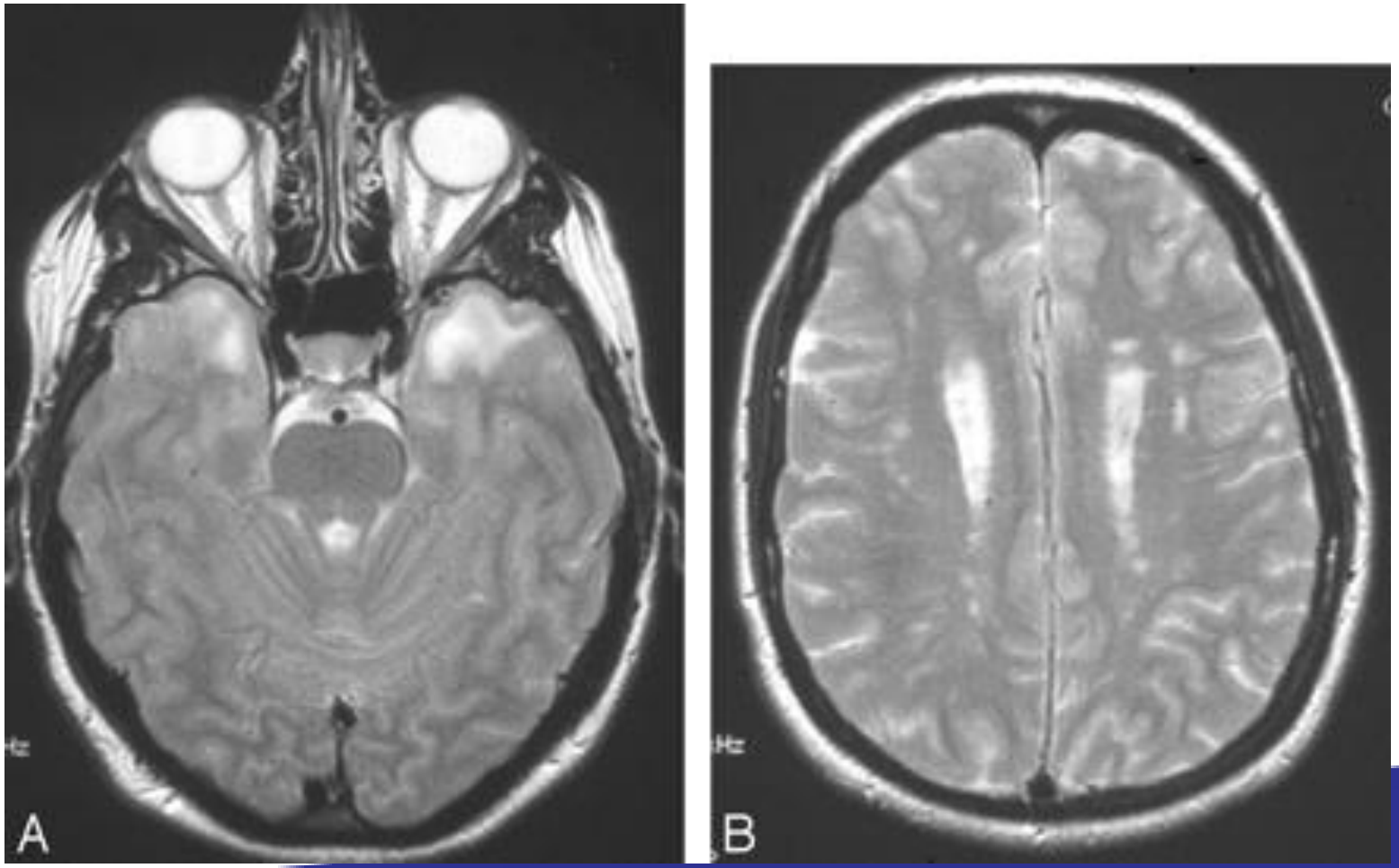
Lancet 2009

When to suspect CADASIL on MRI?

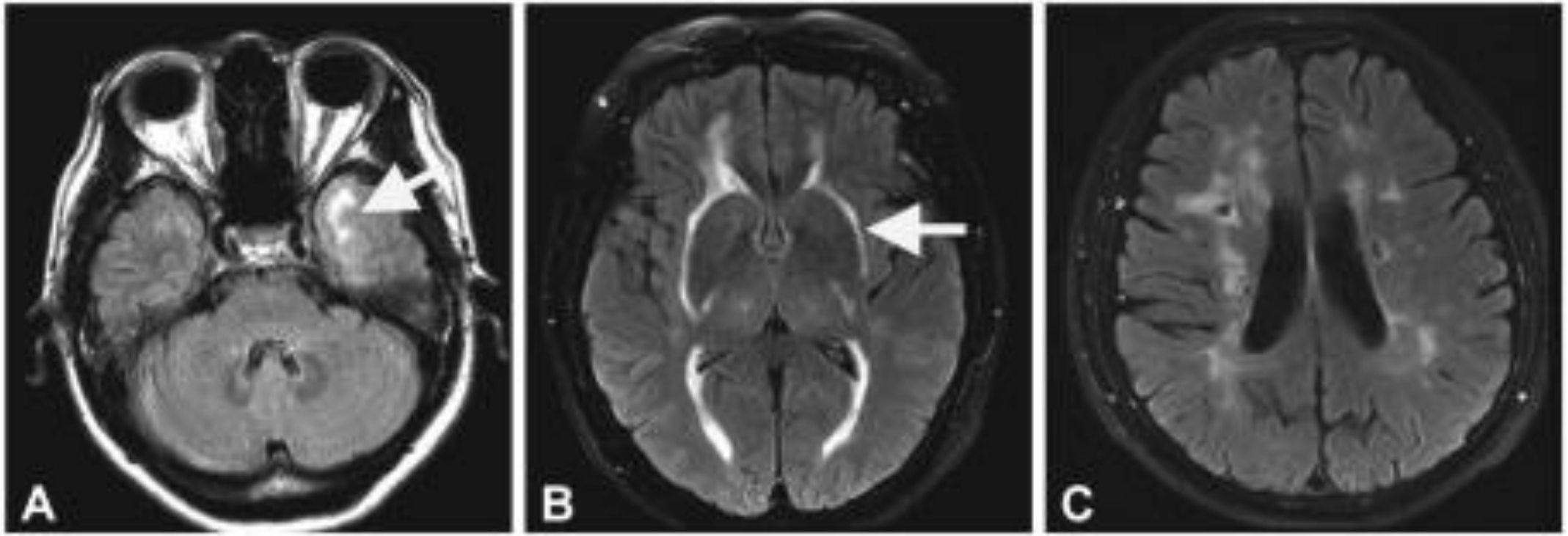


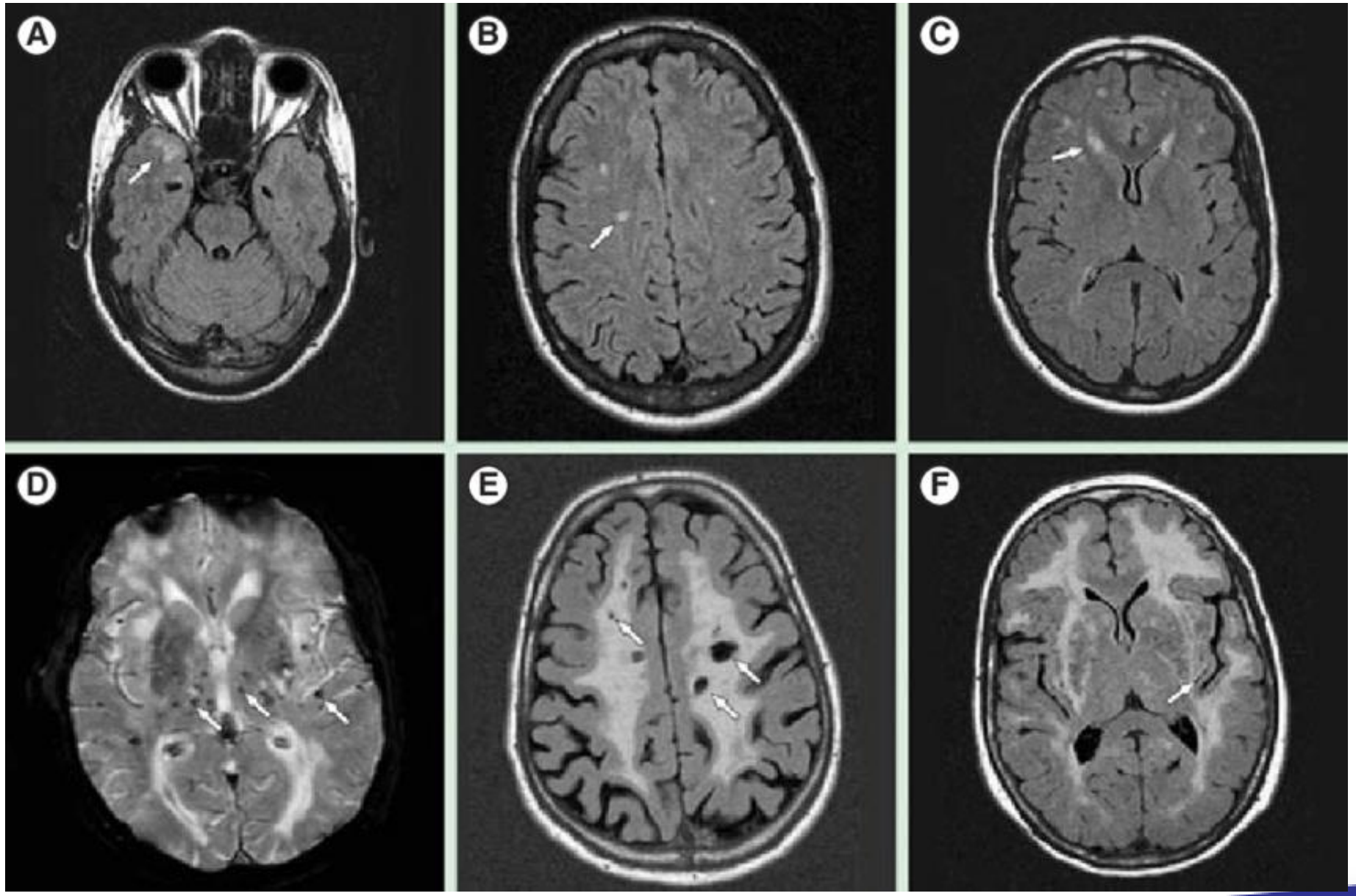
- MA is observed in almost half of all CADASIL patients.
- Atypical aura symptoms are reported by more than one in two of them.
- MA is often the first symptom, can remain isolated and is not associated with the severity of the disorder.

- A **33-year-old woman** who had experienced **classical migraine with aura** since her teens, but was **otherwise asymptomatic**.
- **Marked anterior temporal pole involvement** in the presence of much lesser involvement of other white matter structures.



A patient with migraine with aura and stroke-like attack.

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A patient with recent onset headache and typical demyelinating lesions on MRI.

MS or RIS?

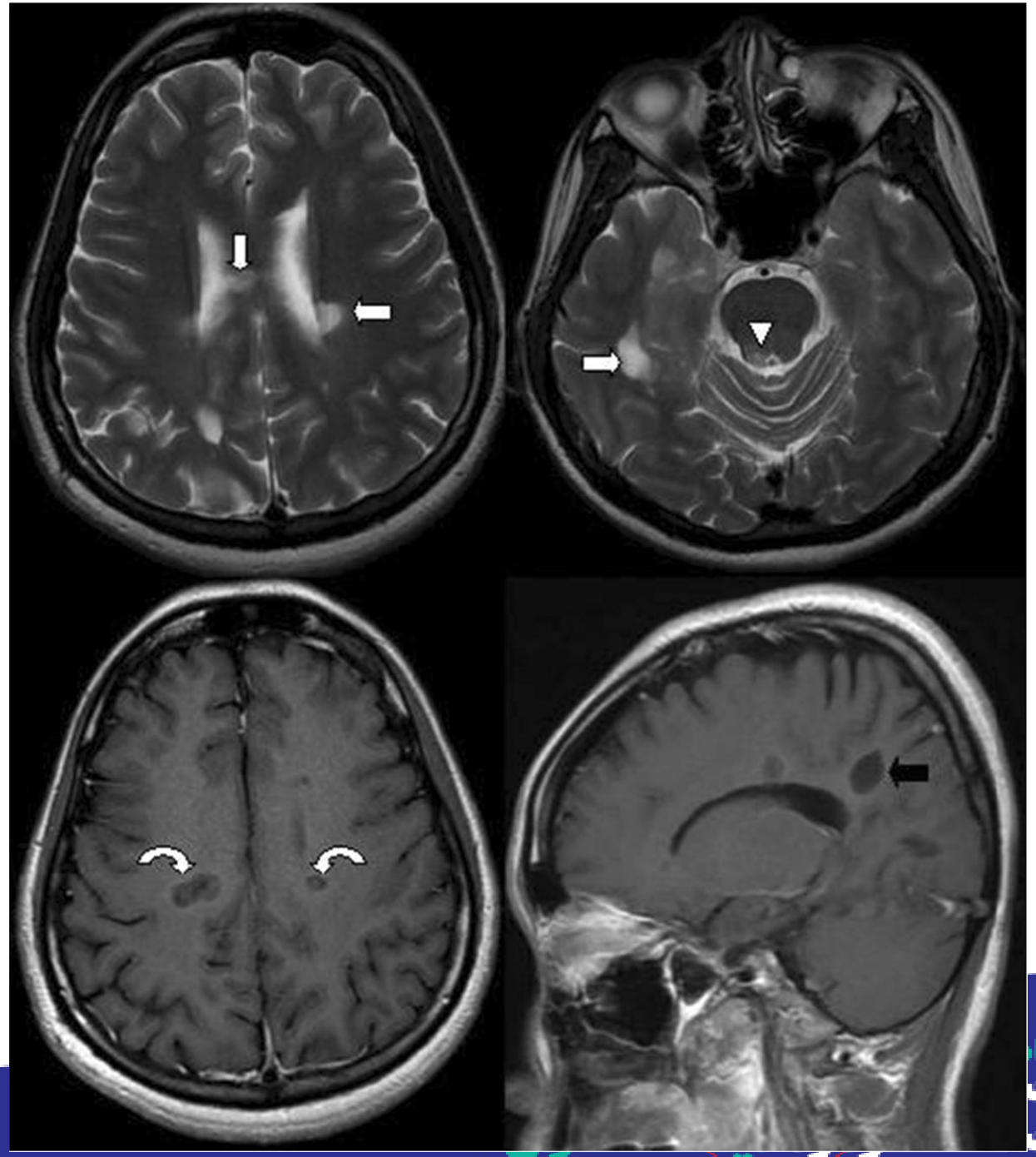
What we know in patients presenting with HA and demyelinating lesions on brain MRI

- ❑ Most patients with RIS are diagnosed in patients with **episodic migraine**.
- ❑ **Prominent HA** is NOT a typical manifestation for MS.
- ❑ Rule out vasculitis/Susac in any patient with prominent HA and suspected lesions on MRI.

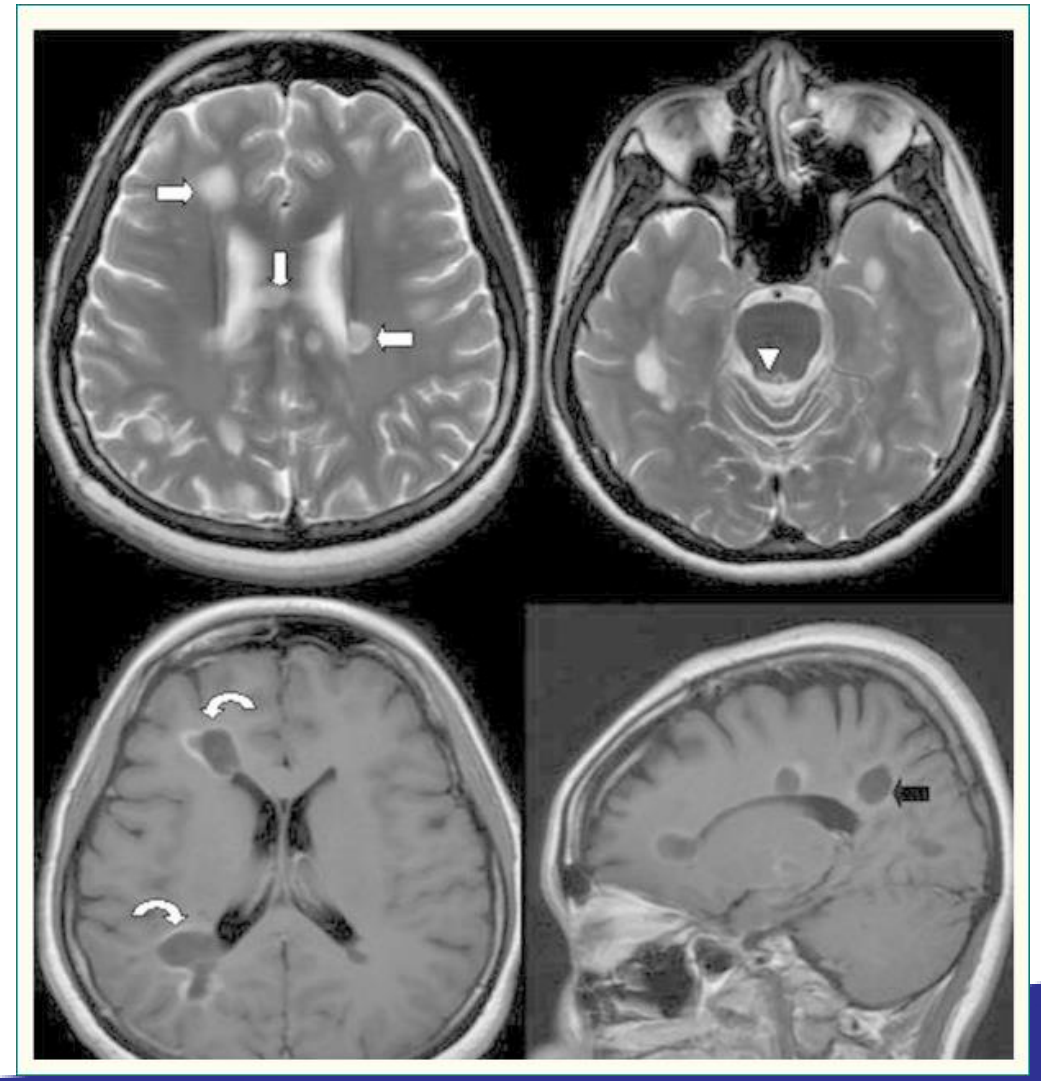
A young woman presenting with worsening migraine

- 31 year old lady presenting as worsening migraine HA associated with blurred vision, photophobia and vomiting from one week ago.

Is it CIS/MS?

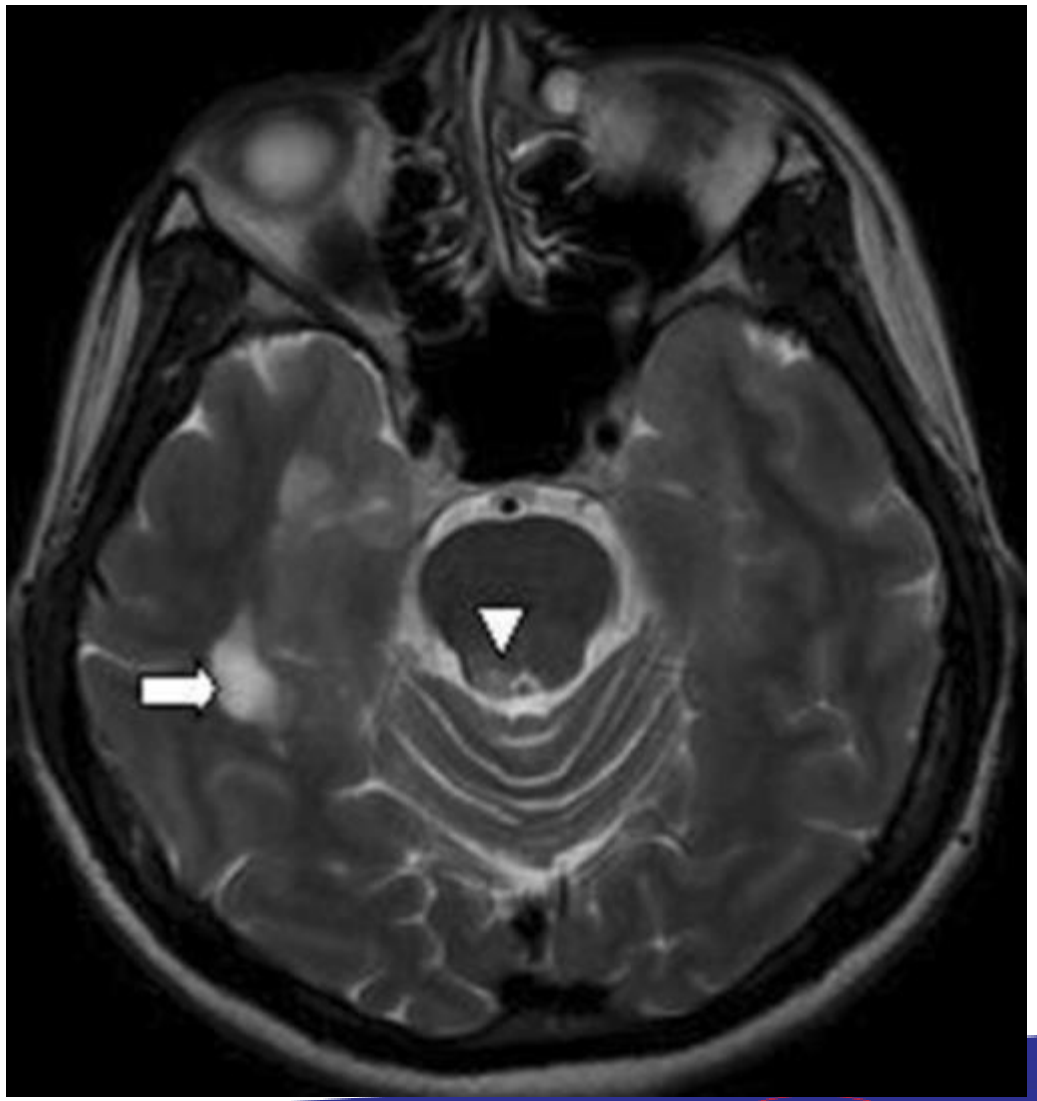


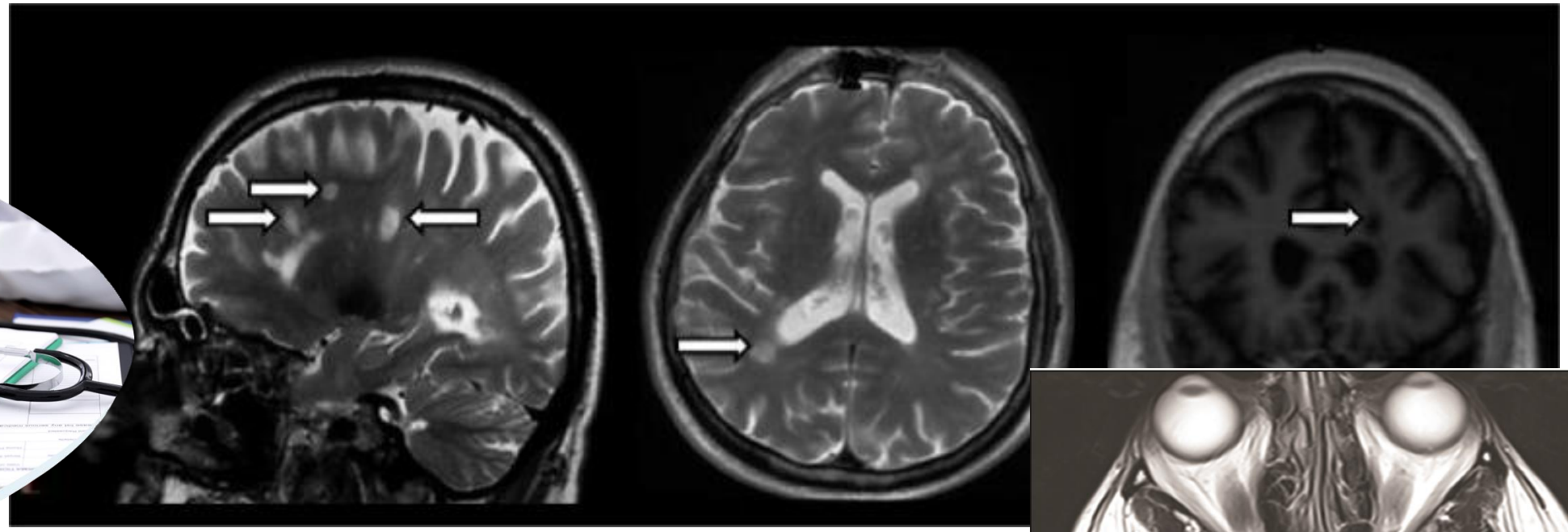
The patient developed facial numbness and ataxia one month later with continuing headache



Clinical lesson

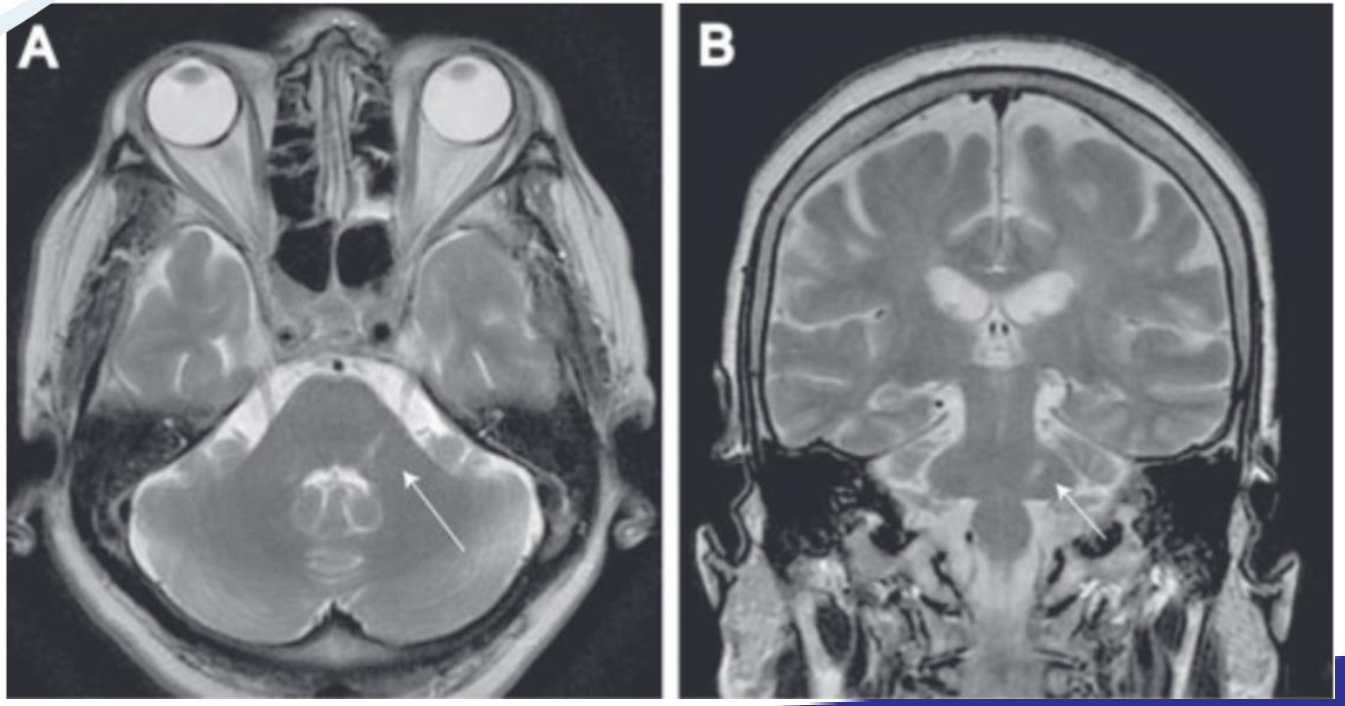
- Prominent/persistent headache can be a presenting symptom of CIS/MS in the presence of PAG lesions.
- It can be a de-novo migraine type HA or aggravation of pre-existing migraine.





- ✓ **45-year-old male**.
- ✓ **3-5 very sever pain attacks/day, each lasting about 60 minutes.**
- ✓ Stabbing pain in the left eye, spreading to the left side of the head, **associated with red eye, lacrimation, nasal congestion and rhinorrhea**, also on the left side.
- ✓ Not responding to several NSAIDs.

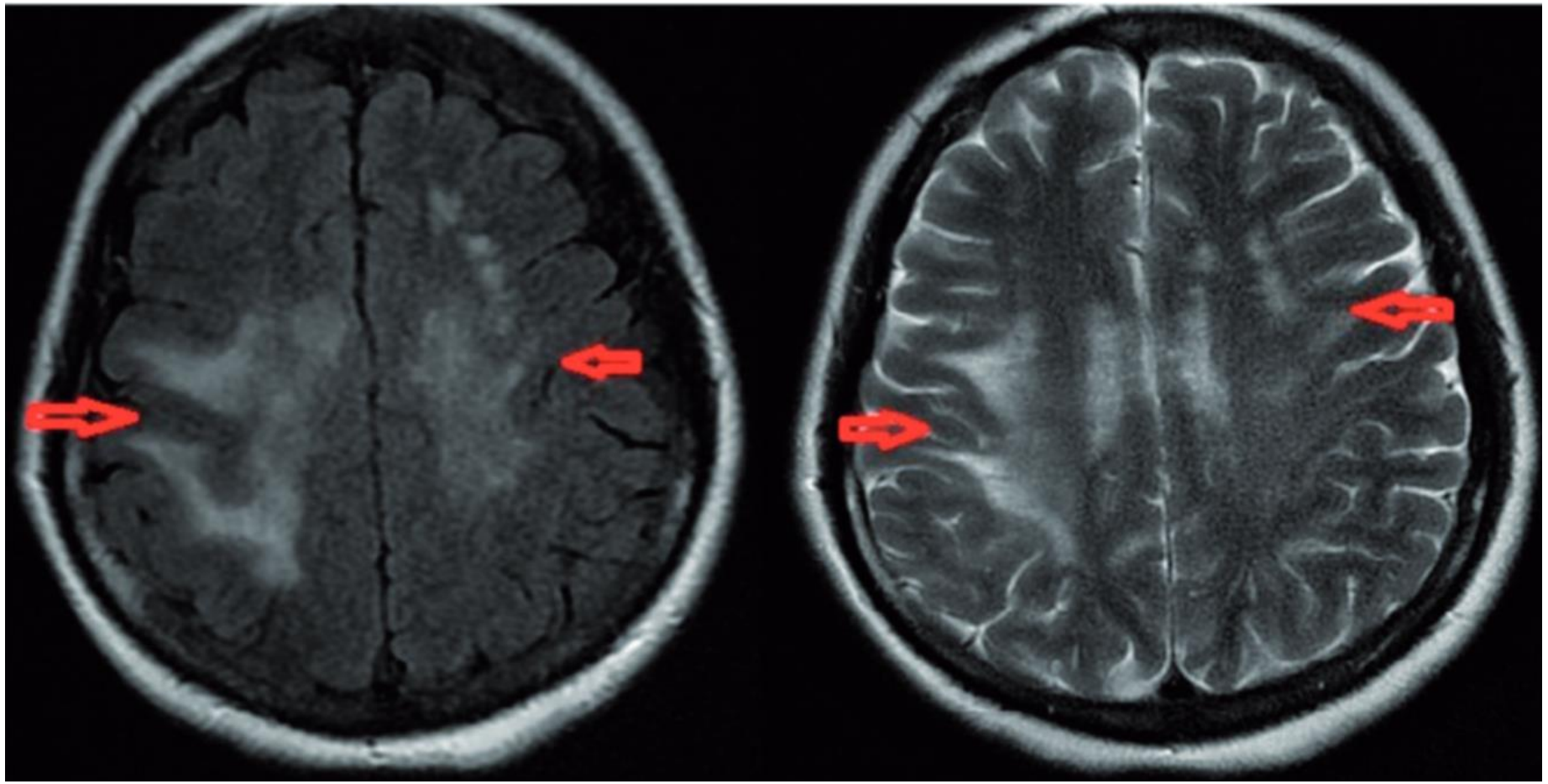
A middle-aged woman with **left sided SUNCT-like status headaches** who was finally diagnosed as MS.



A young woman with right sided TAC like attacks

- A 43-year-old woman with a 2-month H/O severe stabbing/burning pain in the right temporal area.
- 10-20 times/day, each lasting 20-40 seconds, accompanied by red eye & tearing of right eye.
- She was diagnosed with SUNCT.
- Treatment with carbamazepine and lamotrigine had little effect.

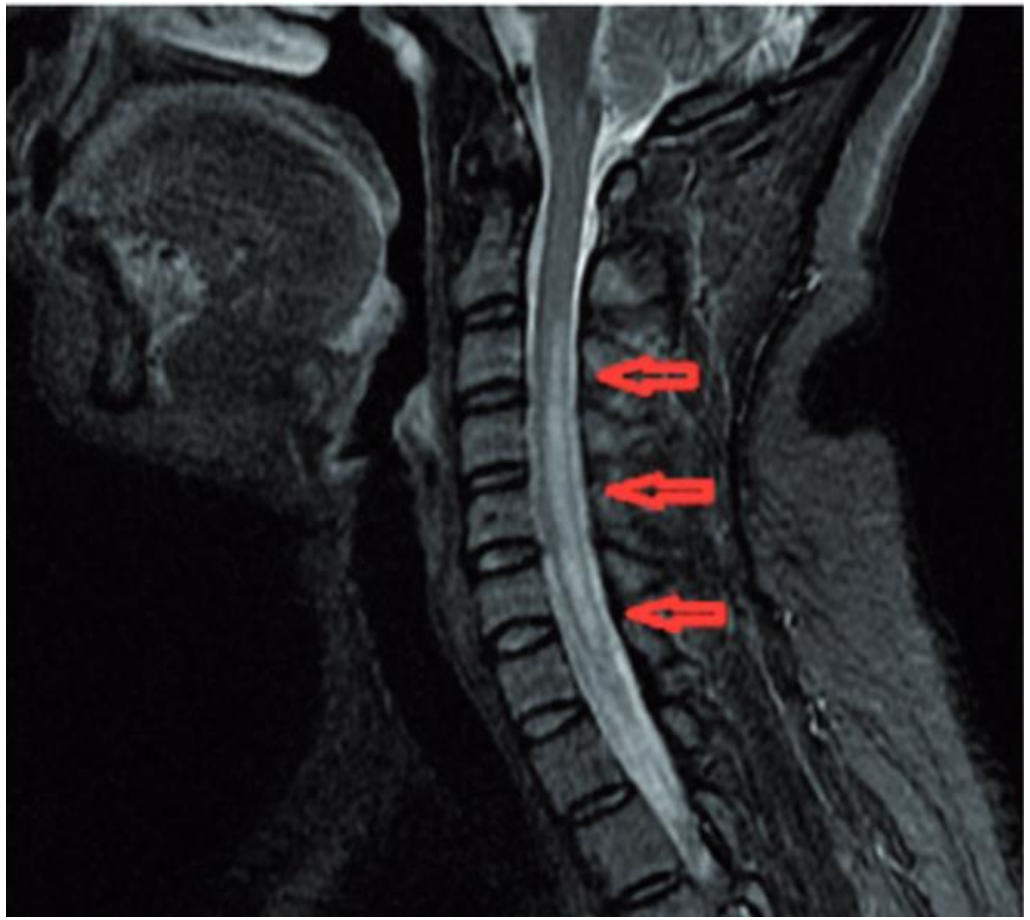
Initial Brain MRI- No cord lesion

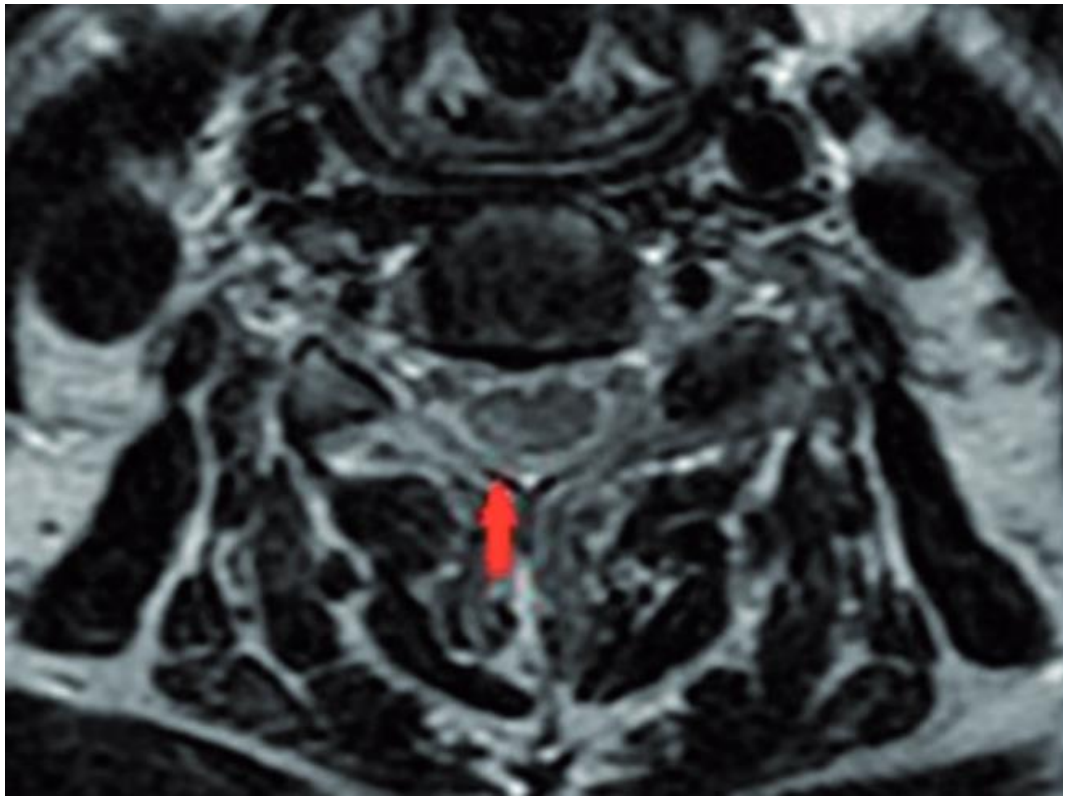


6 weeks later

- The patient developed bilateral visual loss.
- Developed acute tetraparesis and urinary retention over the following day. A few.
- T4 sensory level to all modalities and Lhermitte's was also present.

Optico-spinal syndrome with LETM led to Positive NMO Ab test.



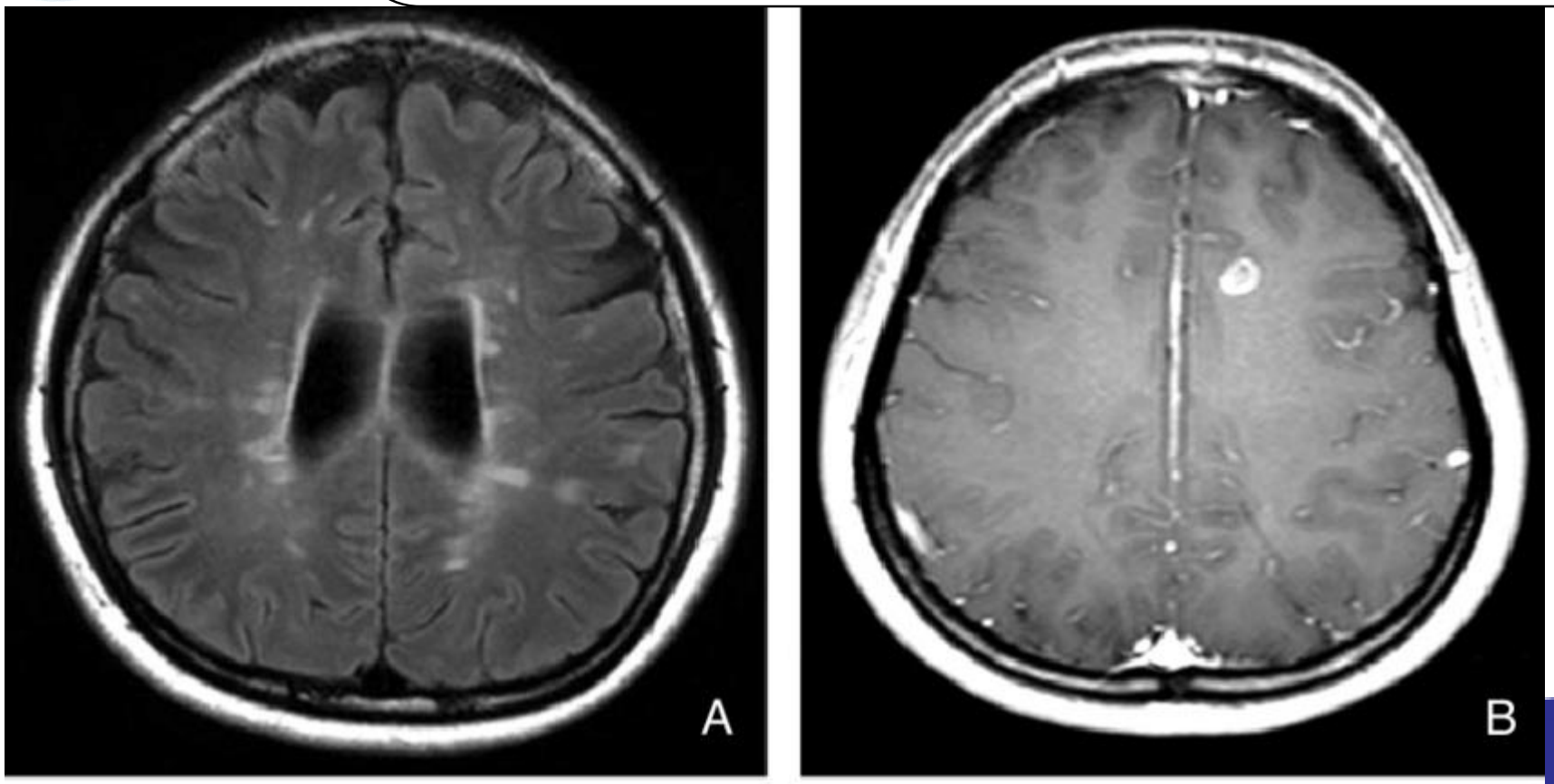


- A 39 year old male, presented with PH like attacks, from the past 2 months.
- 8 attacks/day, each lasting 8 to 15 minutes, associated with red eye and tearing on that side.
- Attacks happened on either side of the head either spontaneously or by touching trigger points on the forehead.
- He had a gradual diminution of vision in the right eye and Lhermitte's symptom for the past 3 months

Clinical lesson

TAC can be a manifestation of MS/NMO in the presence of any lesion in the trigeminal pathways through the brainstem and/or spinal cord.

- A 31-Year old woman with exacerbation of her previous migraine from about 3 weeks.
- She occasional feels dizzy and feels to loose balance.
- Examination seems unremarkable/brisk DTRs on both sides.



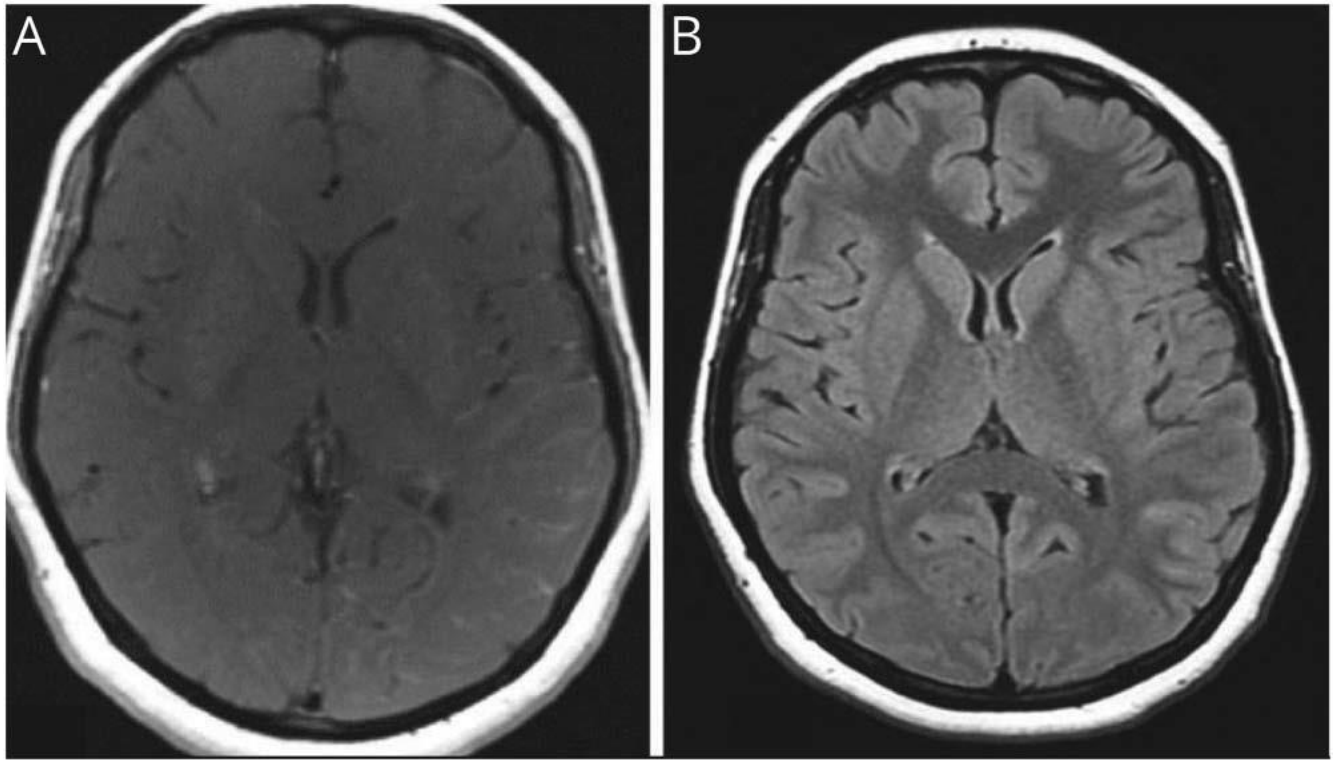
A **New Guest** in Neurology

- A **19-year-old woman** developed a **severe headache with acute-onset and occasional TVO** persisting for 1 week.
- **Bilateral papilledema** was seen on fundoscopy/No other neurologic finding.
- MRI/MRV with contrast venogram was normal.
- CSF analysis showed normal composition, but OP of 27 cm H2O.
- The Dx of IIH was made and She responded to oral acetazolamide at 1000 mg daily for 1 month.

After 3 months

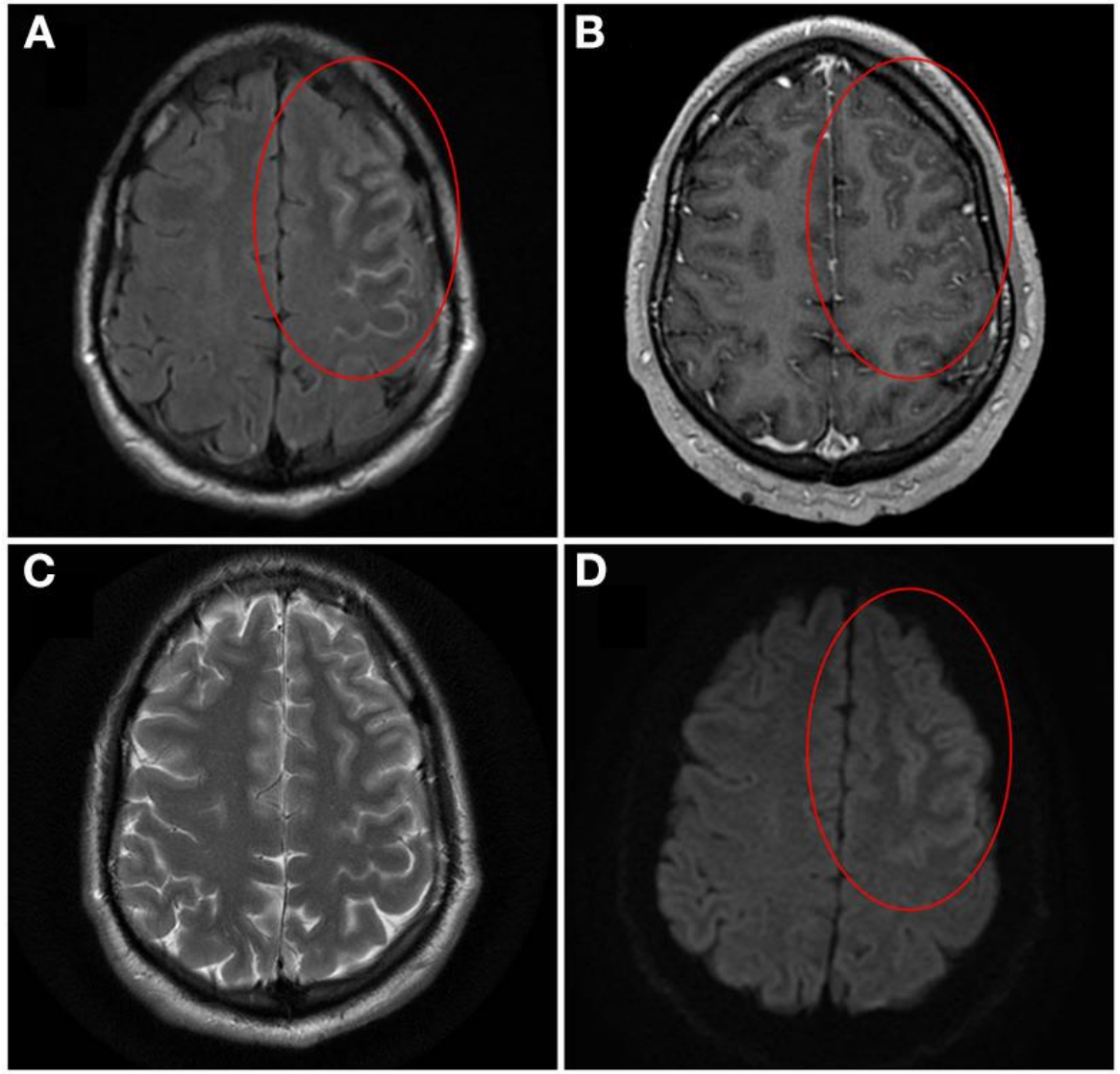
- After 3 months, **the symptoms recurred**, with acute-onset severe headache, vomiting, and intermittent blurring of vision, which was greater in the left eye than in the right.
- She did not have fever, seizures, or altered sensorium.
- Fundoscopy revealed **persistent bilateral disc edema**/ No focal deficit.
- Brain MRI was repeated and it was surprising.

- Leptomeningeal enhancement in left parietal lobe with slight flair hyperintensity in adjacent cortex.
- A repeat CSF tap showed lymphocytic pleocytosis (20 cells) and normal glucose and protein levels. The opening pressure was 35 cm H2O.



Meningo-cortical presentation of MOGAD

- A Clinico-radiologic syndrome
- HA, fever, focal seizure, cortical symptoms, IH.
- Unilateral >>> bilateral, FLAIR >> T2 cortical hyperintensity + LM enhancement.
- Diffusion restriction is often seen.



When to consider headache as a symptom of demyelinating disease?

- Worsening headache and PAG lesions.
- TAC phenotype and MS lesions in any part of trigeminal pathways.
- Headache accompanies other neurological symptoms that are referrable to a particular demyelinating disease based on MRI correlation.
- A Meningo-cortical presentation.

3

A patient with recent onset persisting headache and absent lateral sinus on one side.

Congenital hypoplasia vs Thrombosis?

CVST is liable to missed diagnosis and misdiagnosis

- Affects mainly young females (mean age of 33).
- More likely to present with a non-stroke like neurologic syndrome.
- Often develops more gradually over days, weeks or even months.
- Imaging is diagnostic if performed optimal and timely ordered.
- Hypoplastic sinus and partial recanalization could be misleading.

CVST is liable to missed diagnosis
DO NOT forget unusual presentations

- Isolated headache
- Headache AND Papilledema mimicking IIH.
- Headache AND unilateral tinnitus
- Headache AND unilateral hearing loss
- Headache AND Vertigo/Vomiting/cerebellar ataxia
- Headache AND Aphasia
- Headache AND Multiple lower cranial palsy
- Headache AND CN 6,7,8 palsy
- HA AND psychiatric symptoms

CVST can present as a neuropsychiatric syndrome

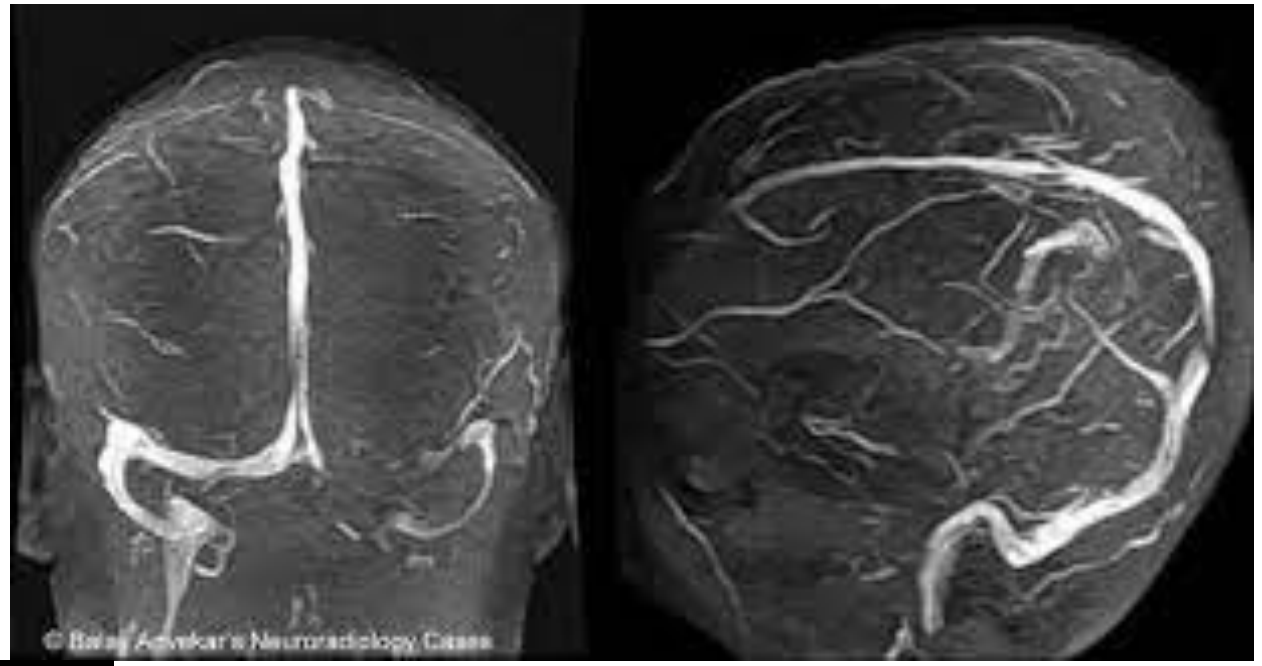
- Delirium
- Psychosis
- Depression/anxiety
- Memory loss
- Personality change, apathy, abulia
- Catatonia

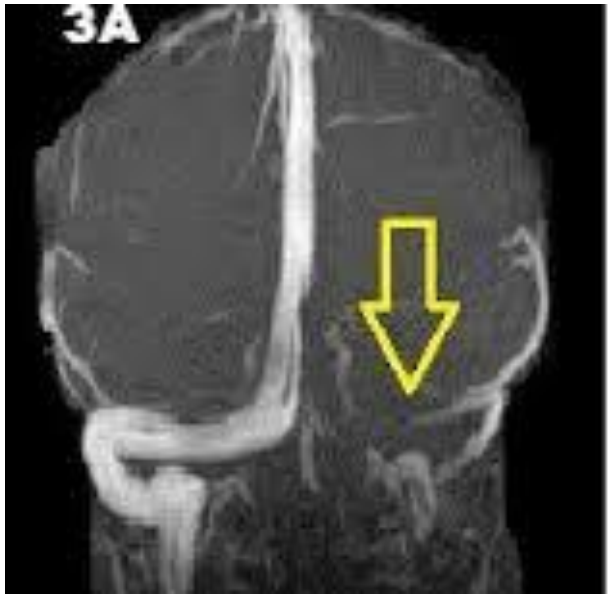
Hypoplasia of transverse sinus

- The right transverse sinus is larger than the left in more than 60% of population.
- The left transverse sinus is atretic or severely hypoplastic in 20–39% of people, with the medial aspect of the left transverse sinus being the most significantly affected.
- When transverse sinus hypoplasia or aplasia is found, the ipsilateral sigmoid and jugular sinuses are usually also hypoplastic or aplastic.

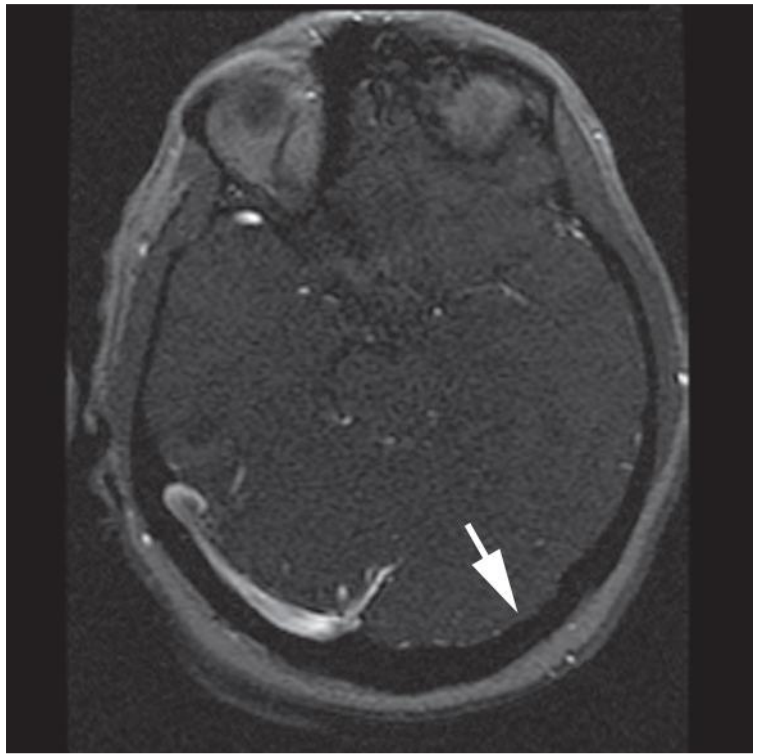
Congenital hypoplasia of TS

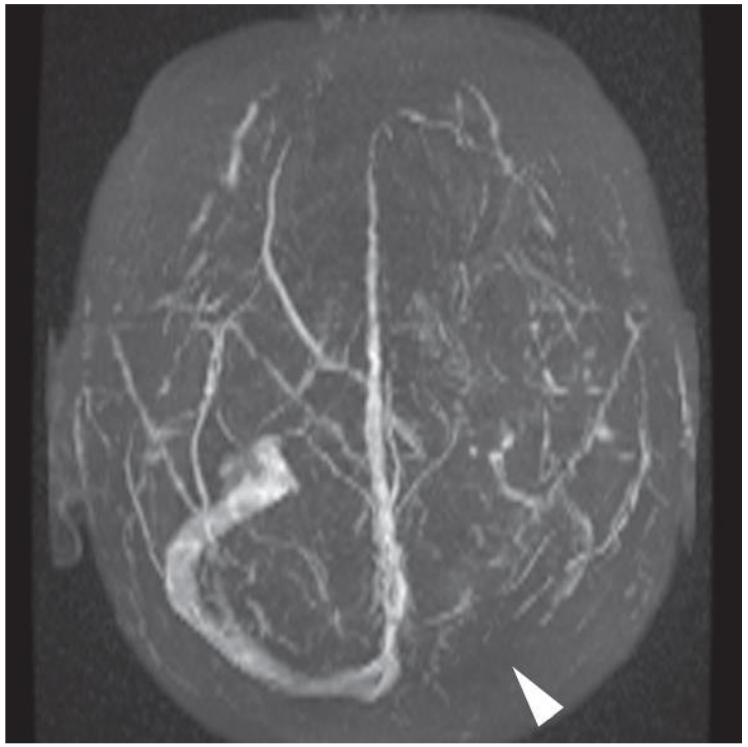
- Often seen on left TS.
- Medial portion of TS is affected.
- Typically the sigmoid sinus & jugular vein s are also hypoplastic.

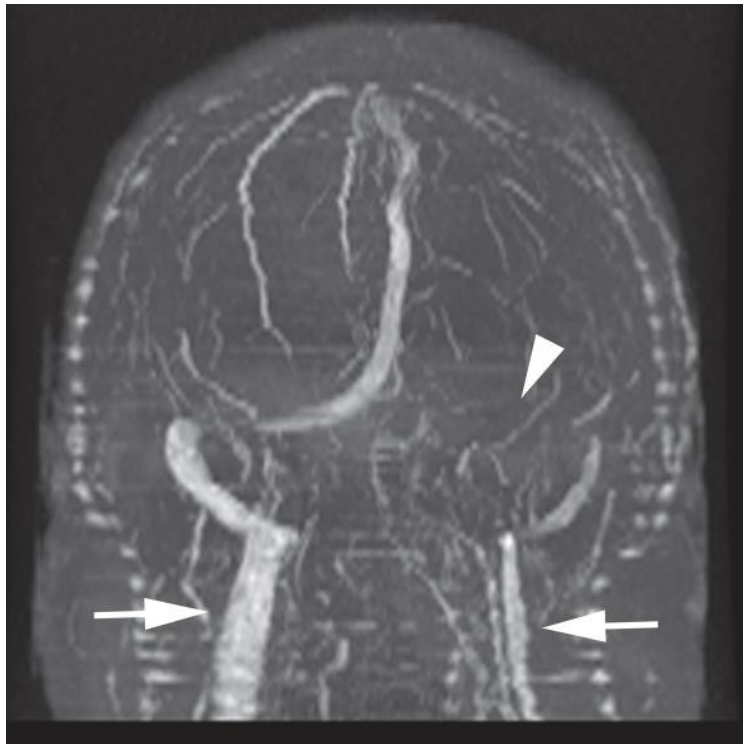




71-year-old woman with headache from 2 weeks ago





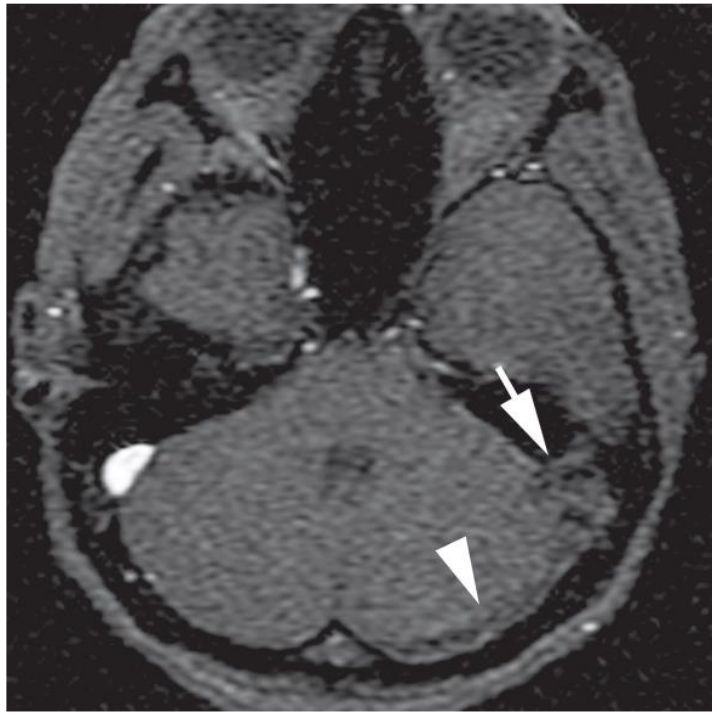


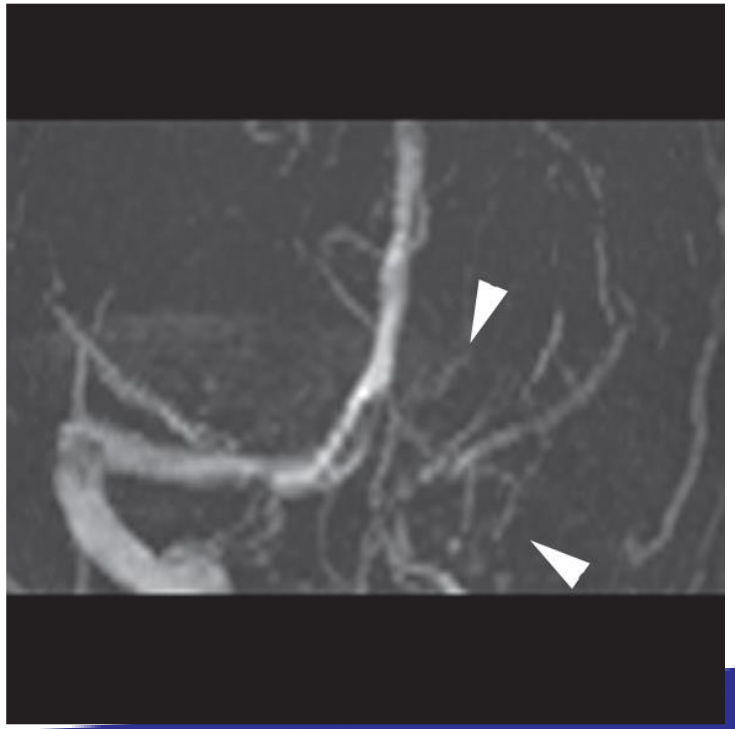
Clues that suggest an etiology other than sinus hypoplasia or aplasia

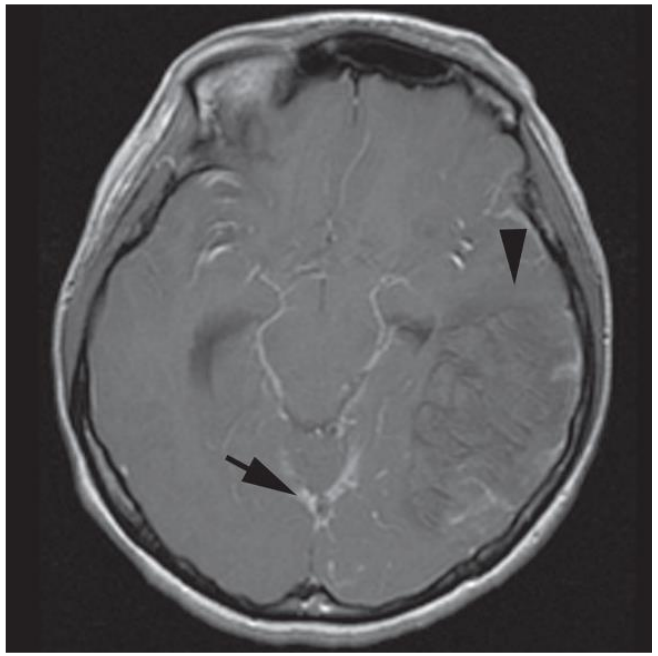
- Secondary signs of thrombosis or injury such as cerebral infarct, edema or hemorrhage.
- Collateral vessel filling or recanalization.
- Intrinsic high T1 signal within a dural sinus.

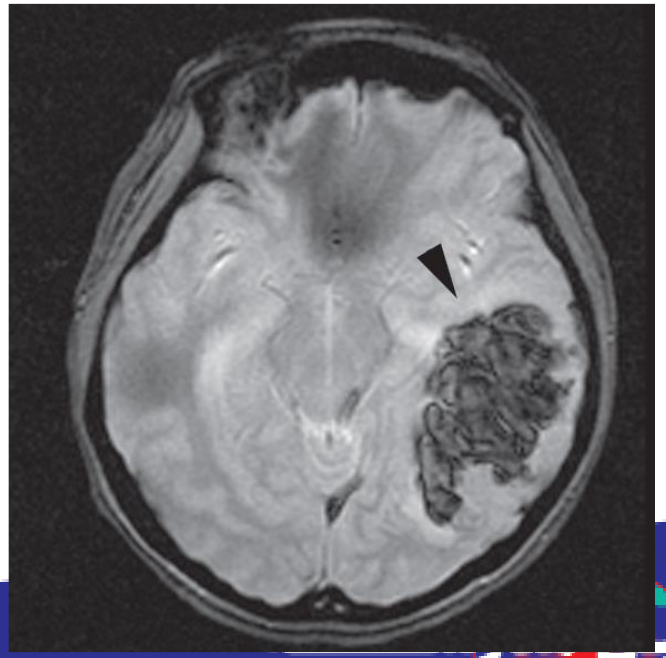
A 52-yaer old man with headache

A. Axial 2D (TOF) MRV shows absence of contrast and complex heterogeneous hypointense signal in the enlarged left transverse (arrowhead) and sigmoid (arrow) venous sinuses.
B. Coronal MRV shows absence of flow within the left transverse sinus and recanalization of subjacent venous collaterals (arrowheads).
C. Axial contrast-enhanced T1-weighted image shows clot extending into the deep venous system (arrow) with a large parenchymal hypointensity consistent with extensive temporal lobe venous infarct (arrowhead).
D. Axial GRE MR image shows blooming of thrombosed blood in both the temporal lobe (arrowhead) and deep venous system.



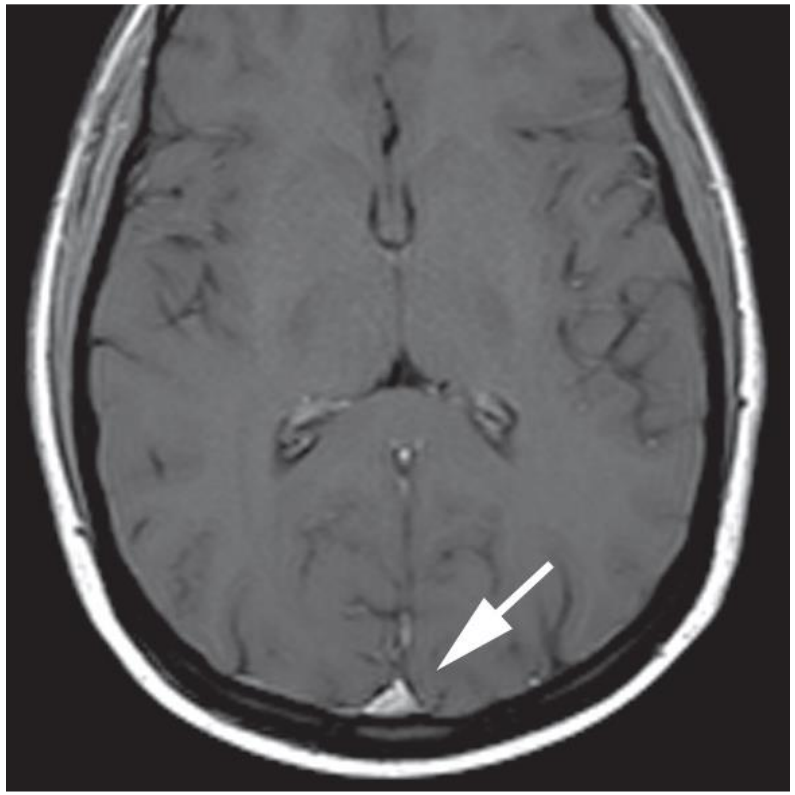


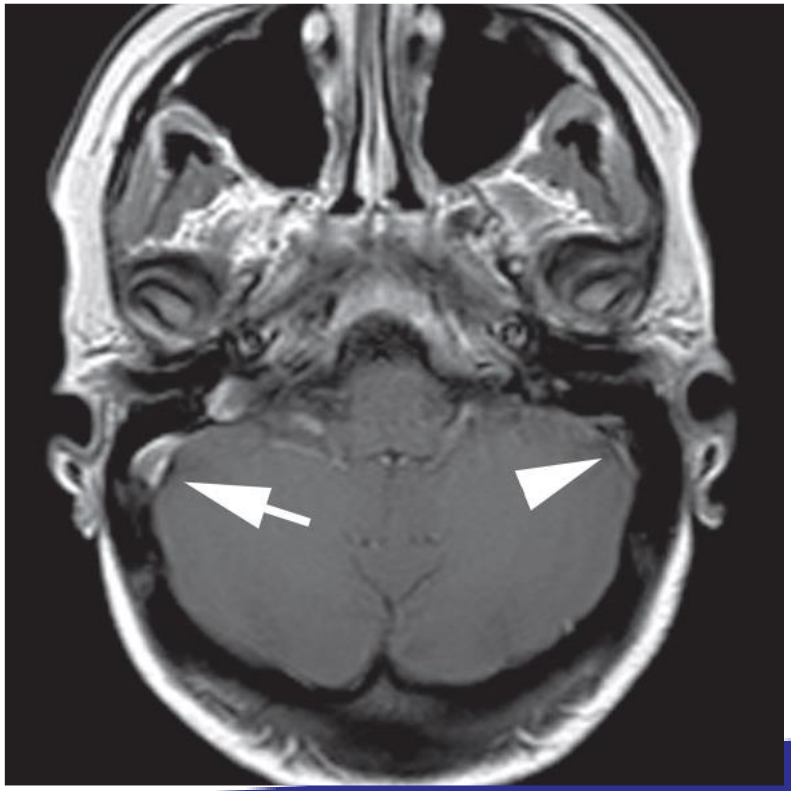


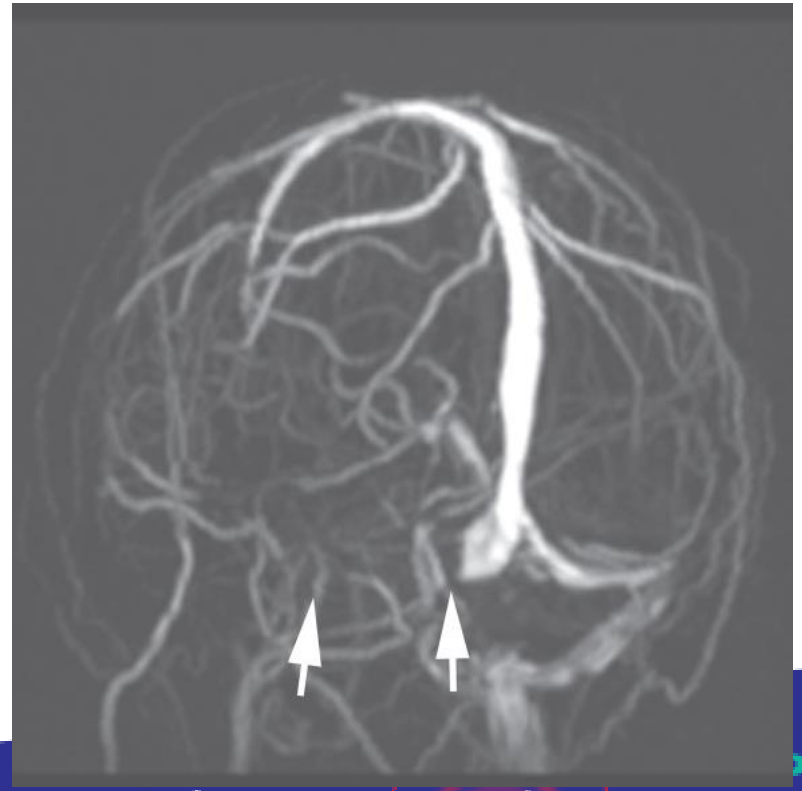


A 35 –year-old woman with postpartum headache

A. Axial T1 MRI shows intrinsic high signal at the sinus confluence (arrow).
B. More inferiorly, at the junction of the right transverse and sigmoid sinuses, there is high signal filling the sinus lumen (arrow), suggesting thrombus. Note the normal flow void on the contralateral side (arrowhead)
C. Oblique coronal MIP image from a TOF MRV shows absent flow within the right transverse sinus (arrows), confirming right transverse sinus thrombosis.





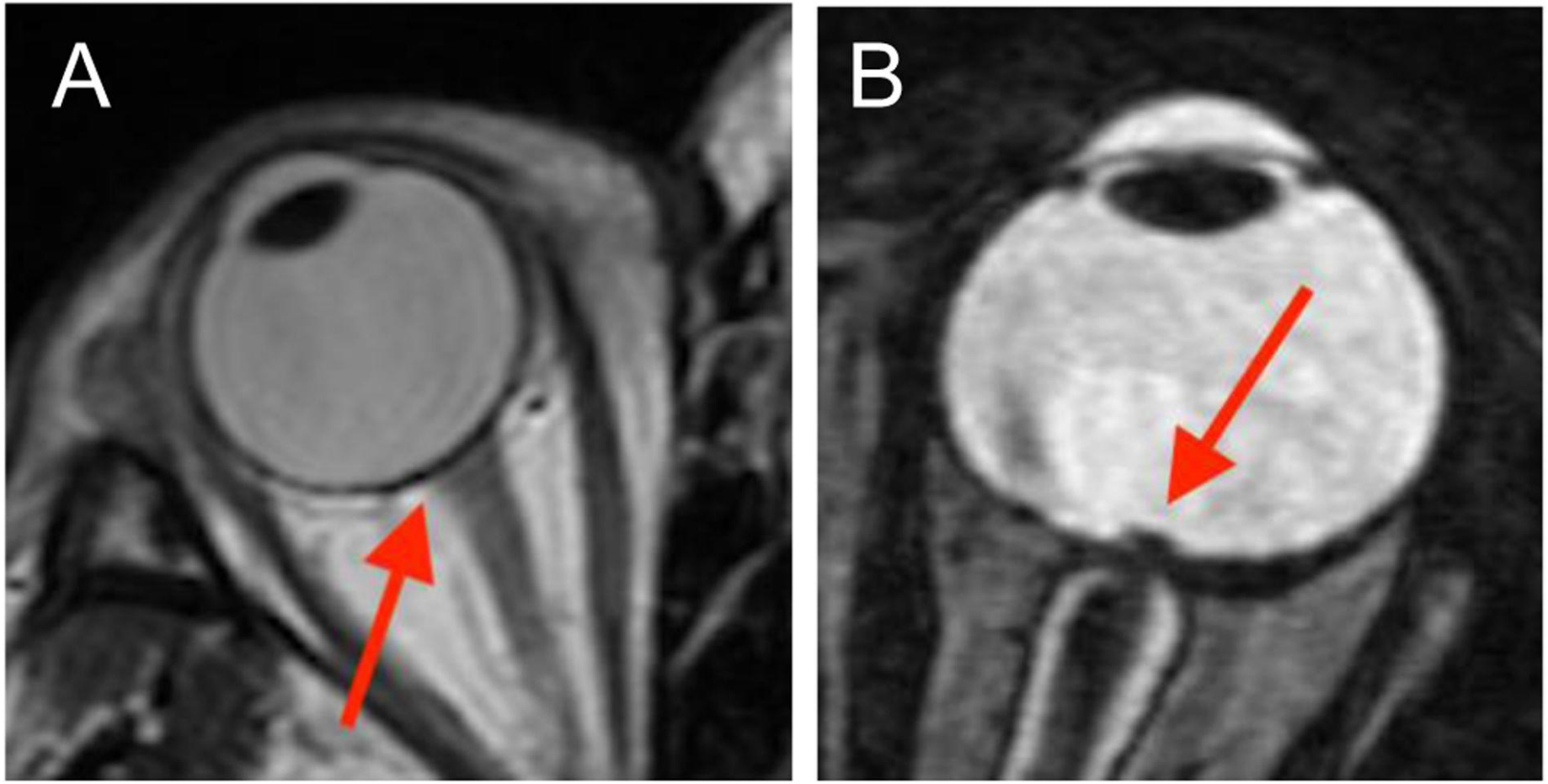


4

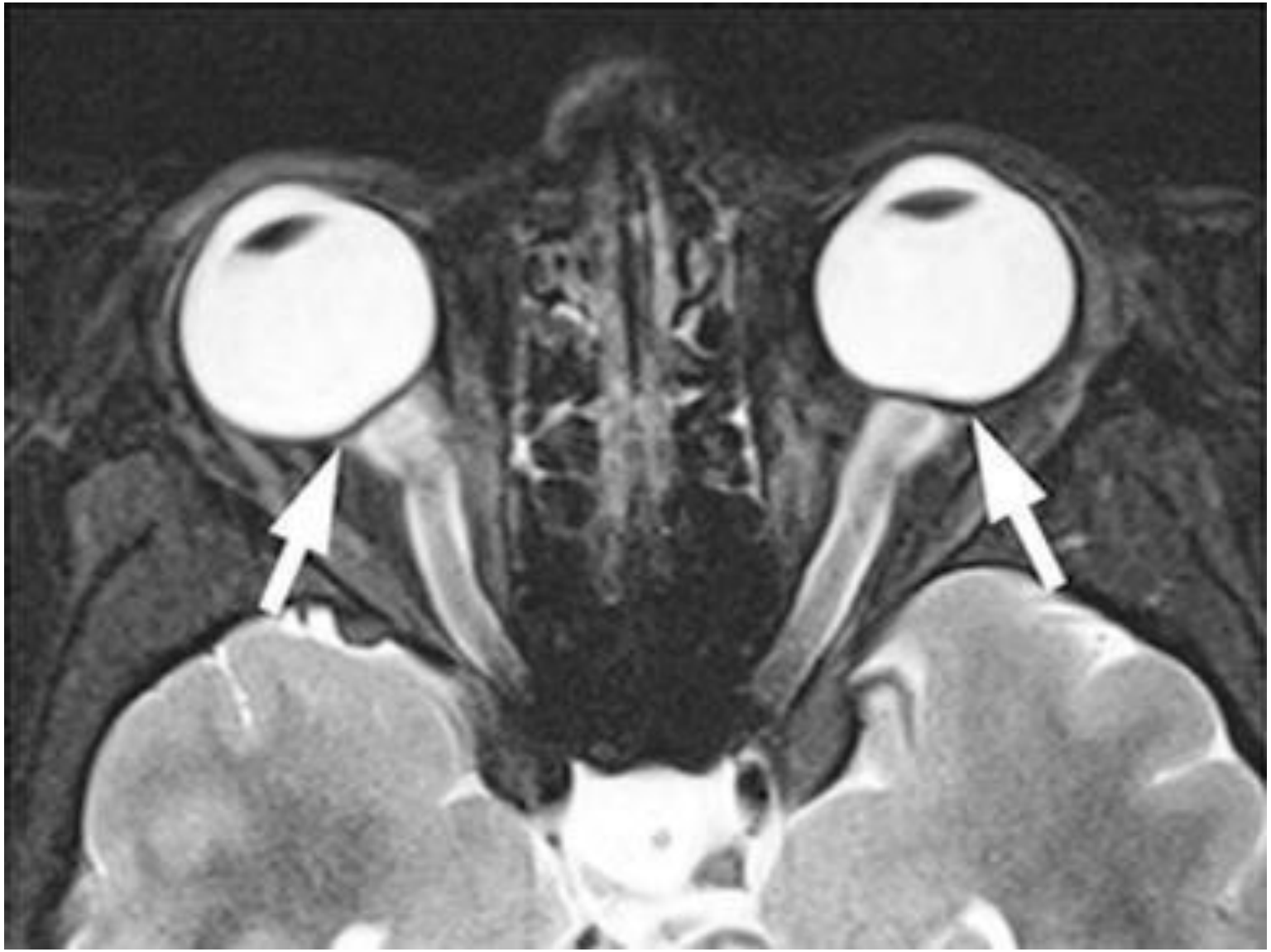
A patient with headache and papilledema.
IIH vs CVST?

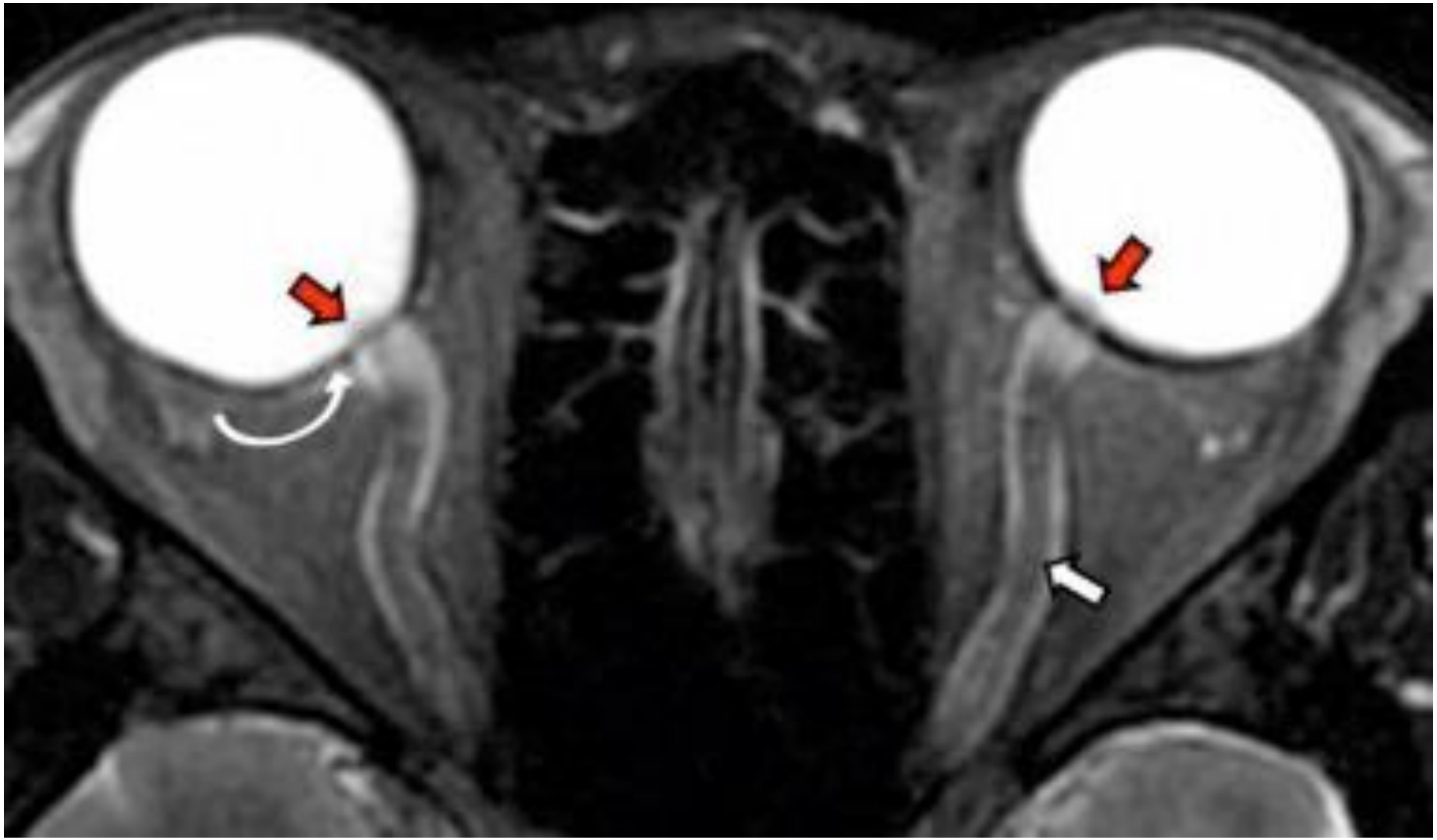
Imaging in IIH

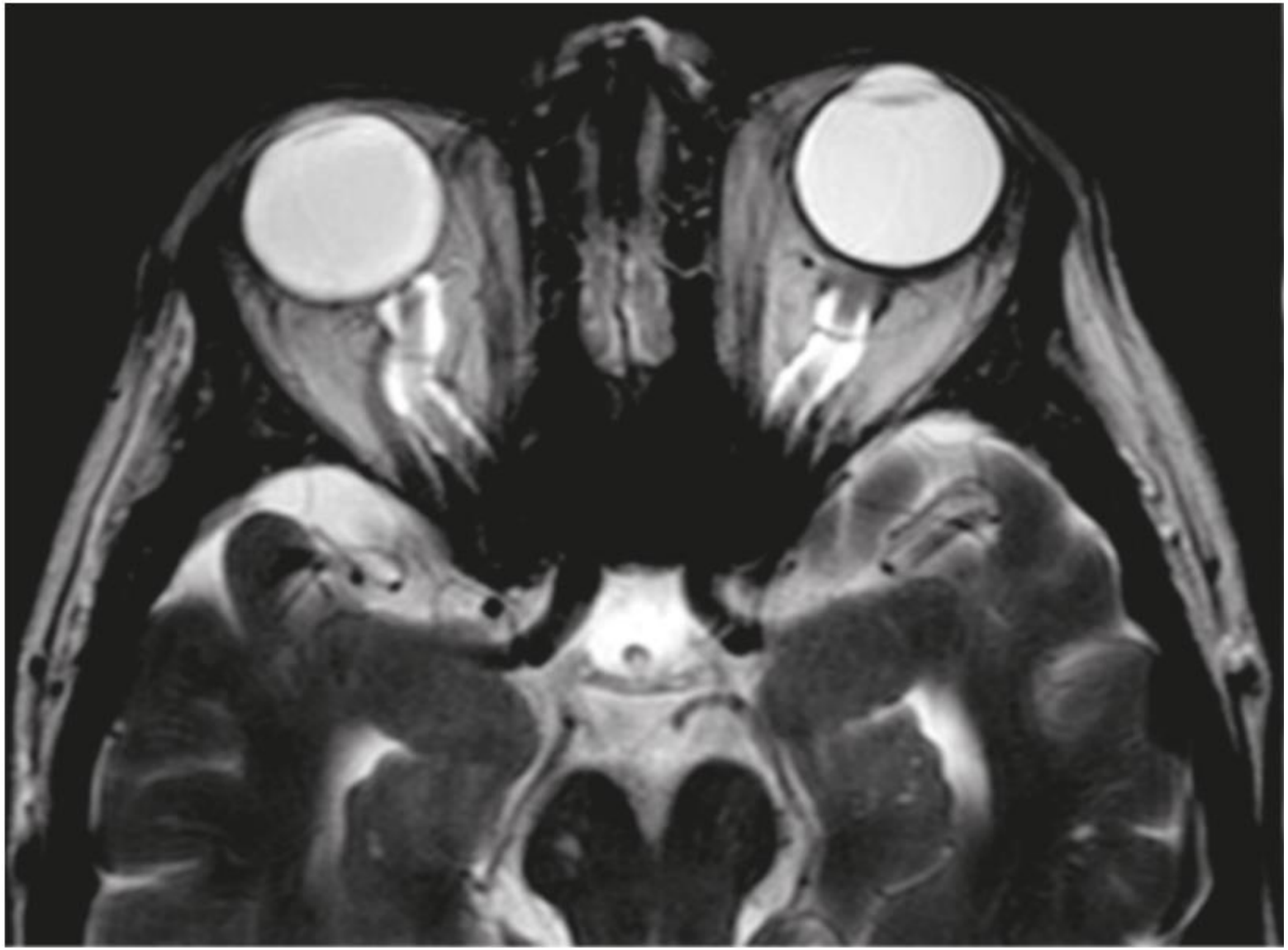
- Almost 5% of IIH patients do NOT have papilledema.
- Can differentiate IIH from CVT in suspected cases.
- The presence of multiple imaging markers increases the likelihood of IIH diagnosis, although absence of these findings does not rule it out.



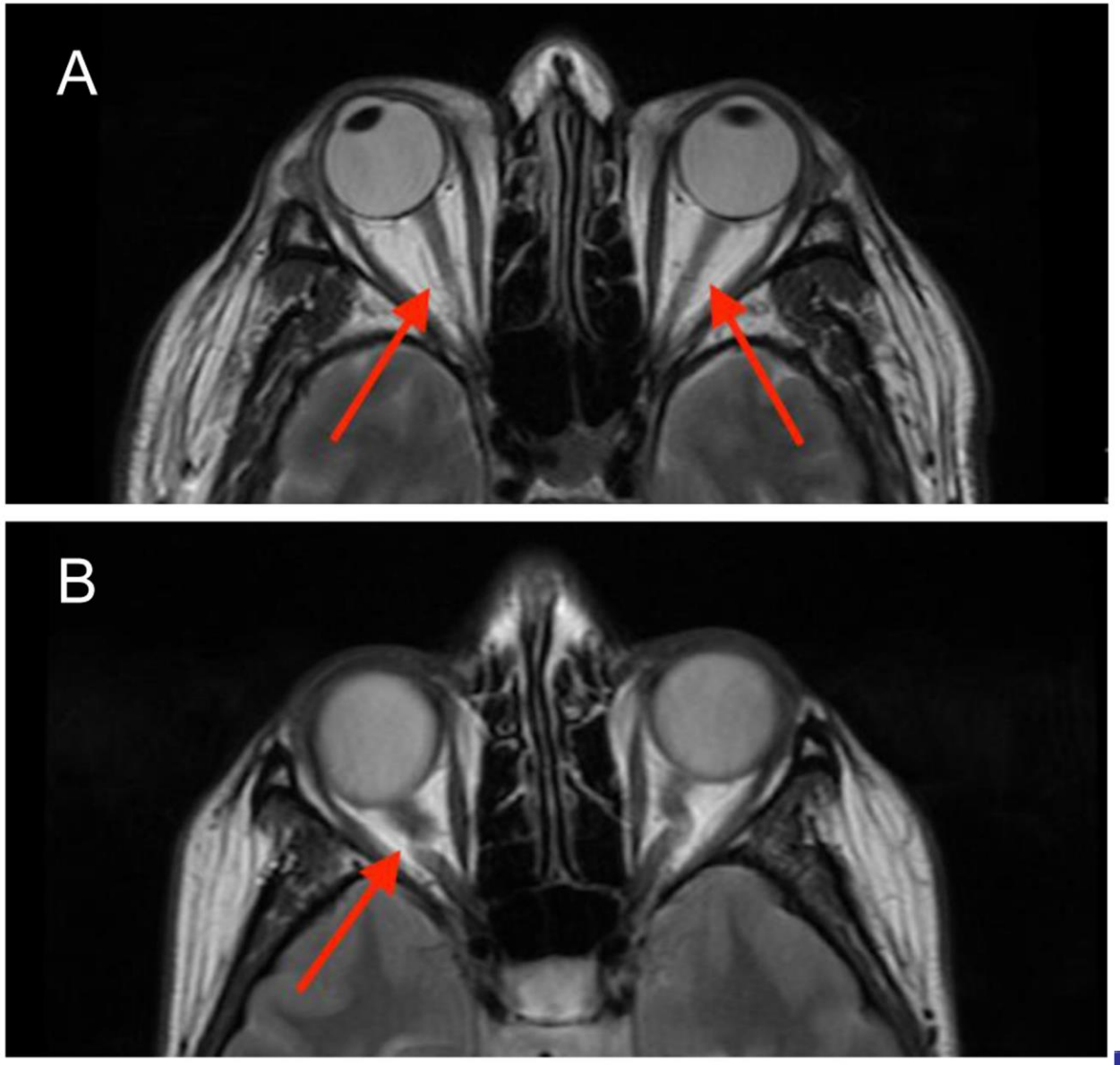
A. Axial T1-weighted MRI shows normal appearance of the optic nerve head. B. Axial T2-weighted MRI orbit demonstrates a swollen optic nerve head (arrow).

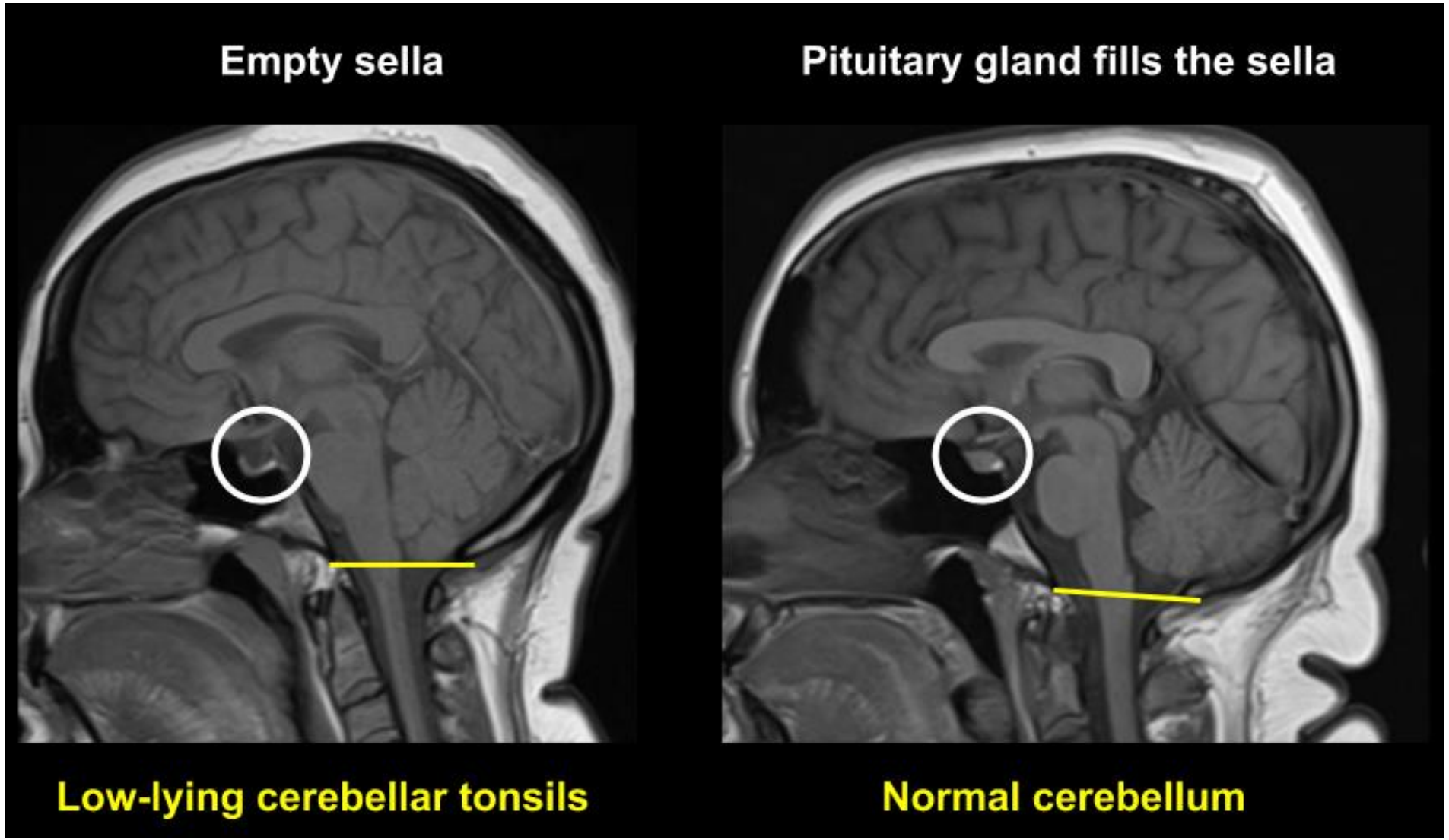


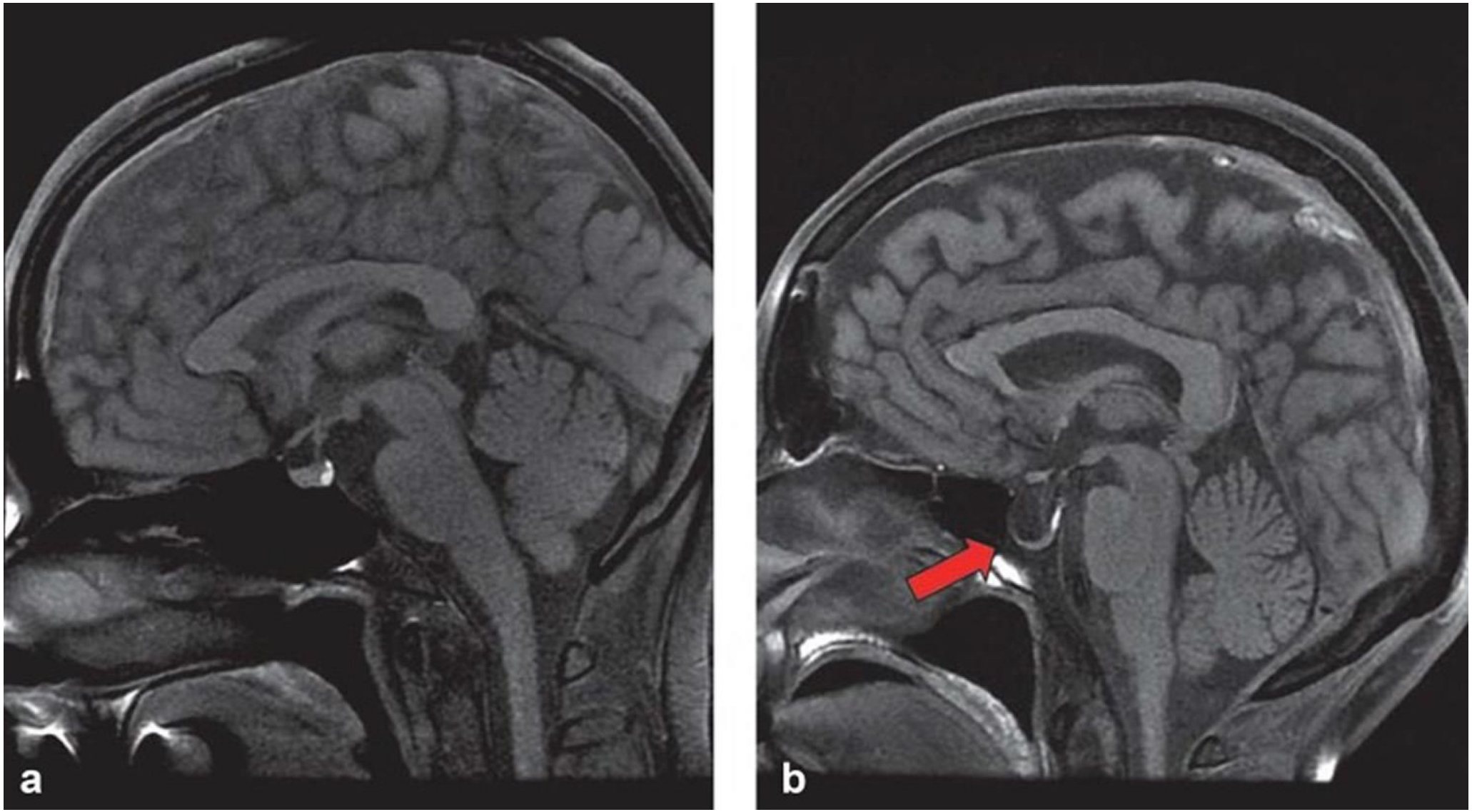


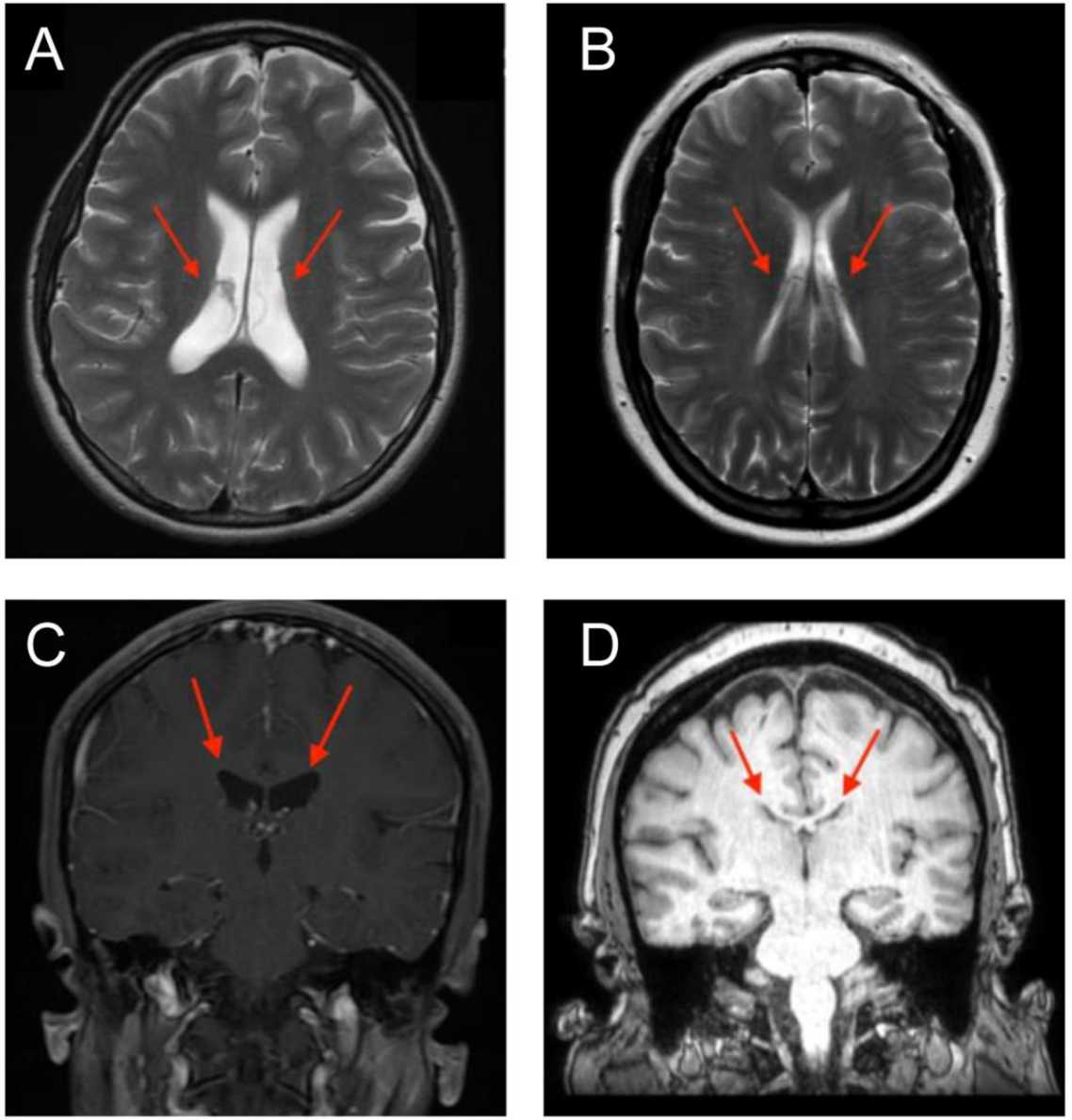


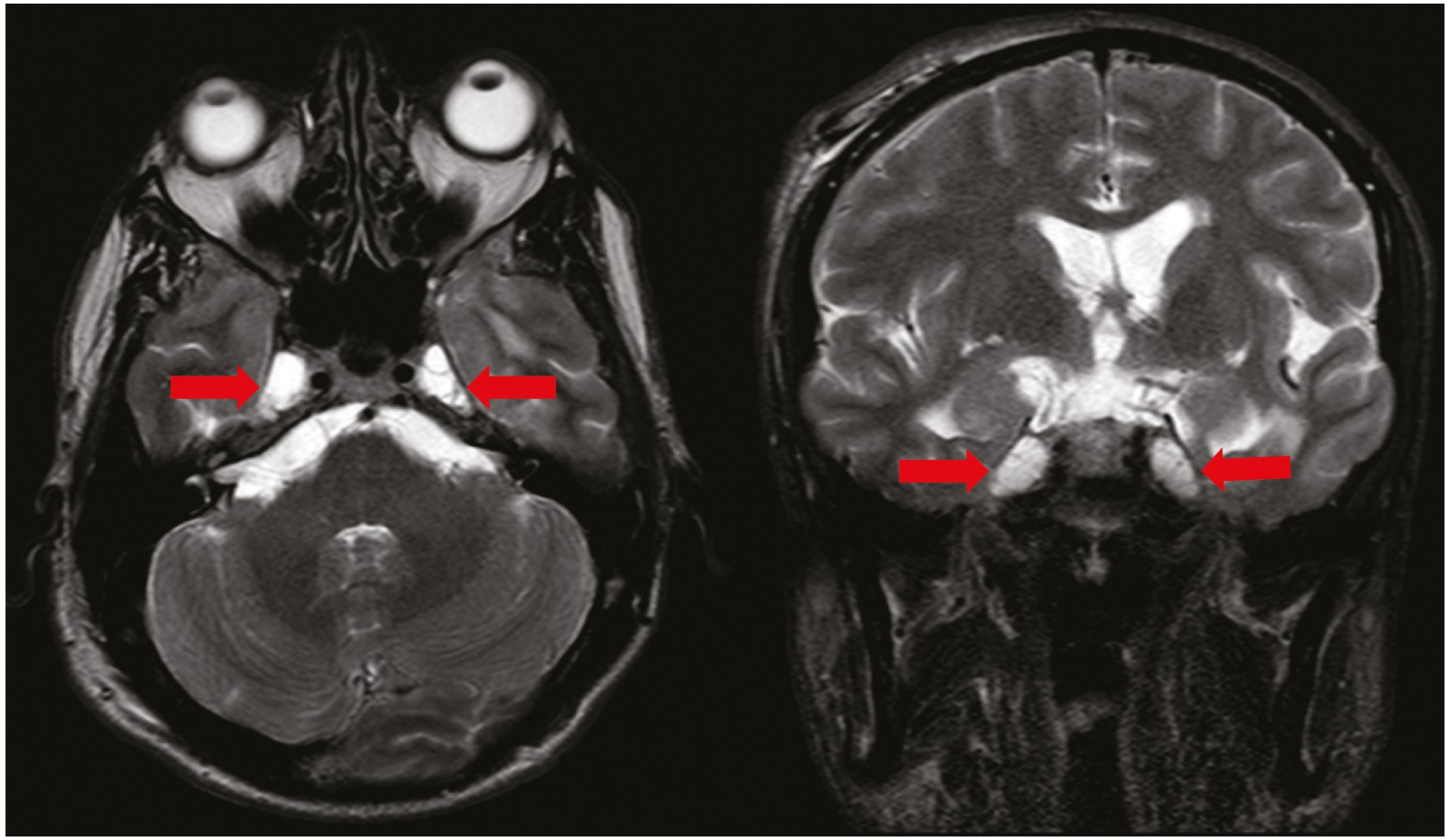
A. Axial T1-weighted MRI demonstrates normal appearance of the optic nerves (arrows). B. Axial T1-weighted MRI demonstrates tortuosity of the optic nerves and presence of a “smear sign” on the right optic nerve (arrow).



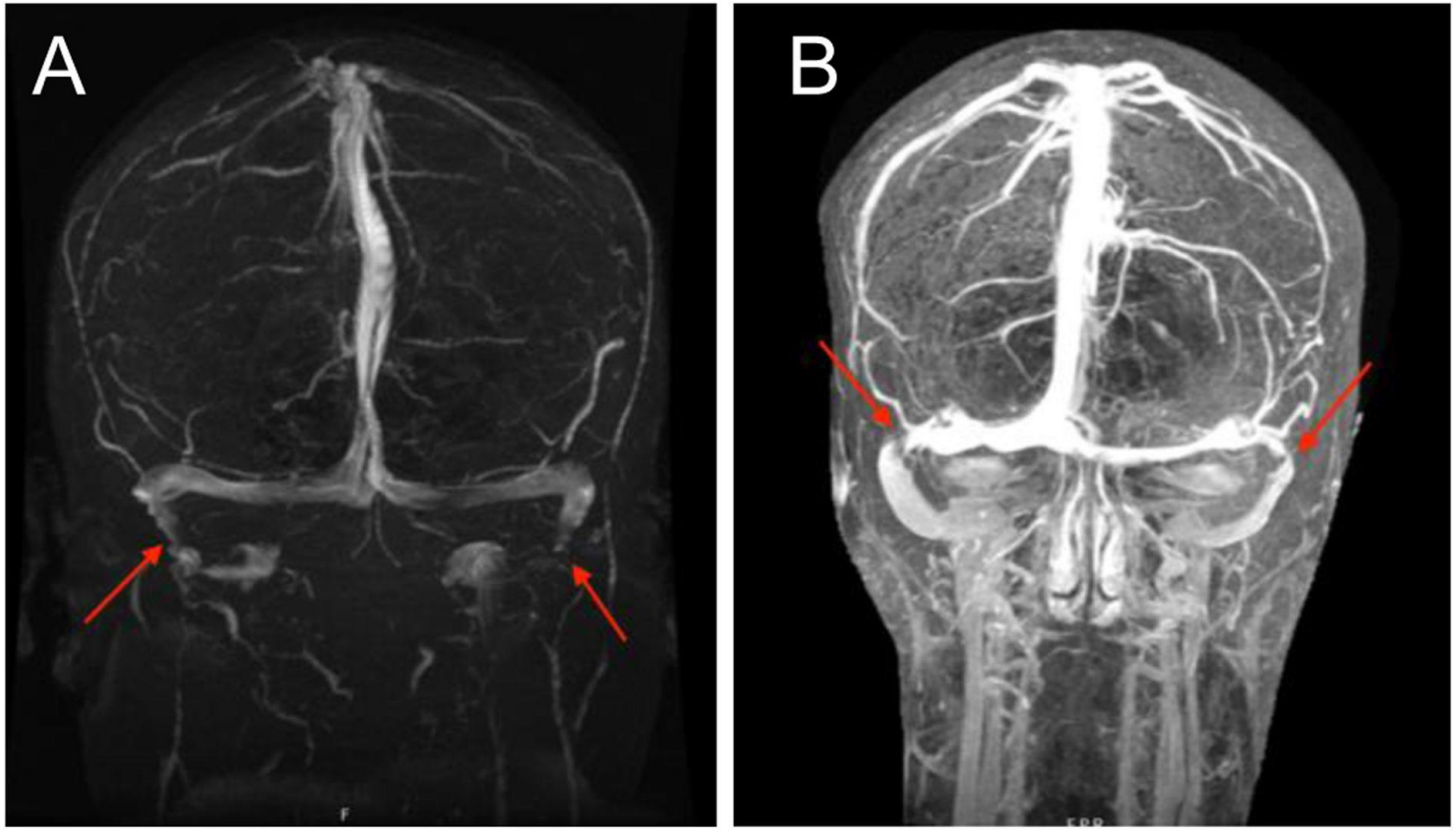

Empty sella
Pituitary gland fills the sella
Low-lying cerebellar tonsils
Normal cerebellum


a
b

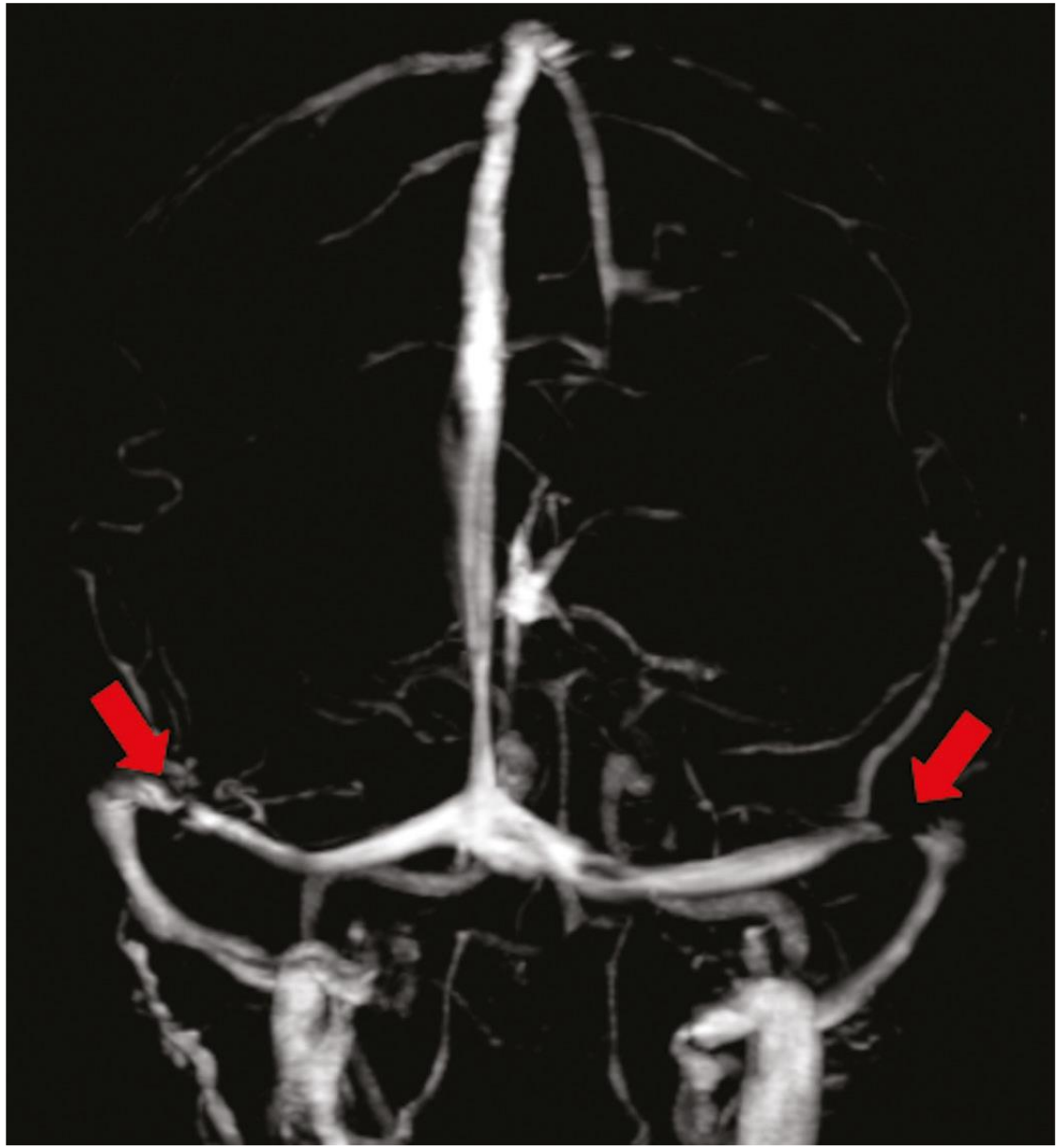

A
B
C
D



Axial and coronal T2-weighted MRI scans (A and B, respectively) showing ectasia of Meckel’s cave (arrows), an alteration that can be observed in the context of IIH.

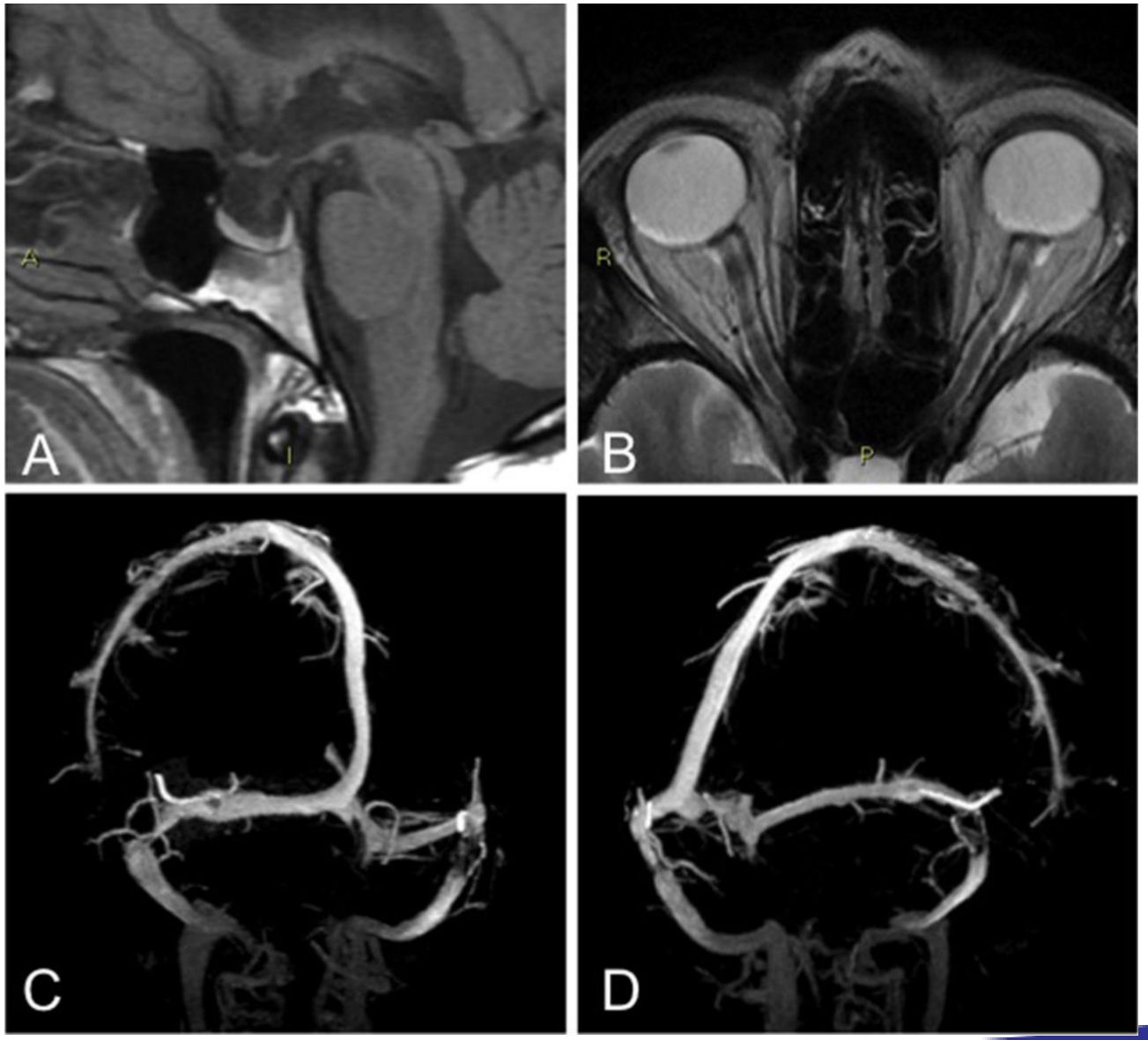


A. Posterior view of magnetic resonance venography (MRV), Coronal T1 without contrast depicts normal venous structure (arrows). B. MRV with contrast demonstrates bilateral transverse sinus stenosis (arrows).

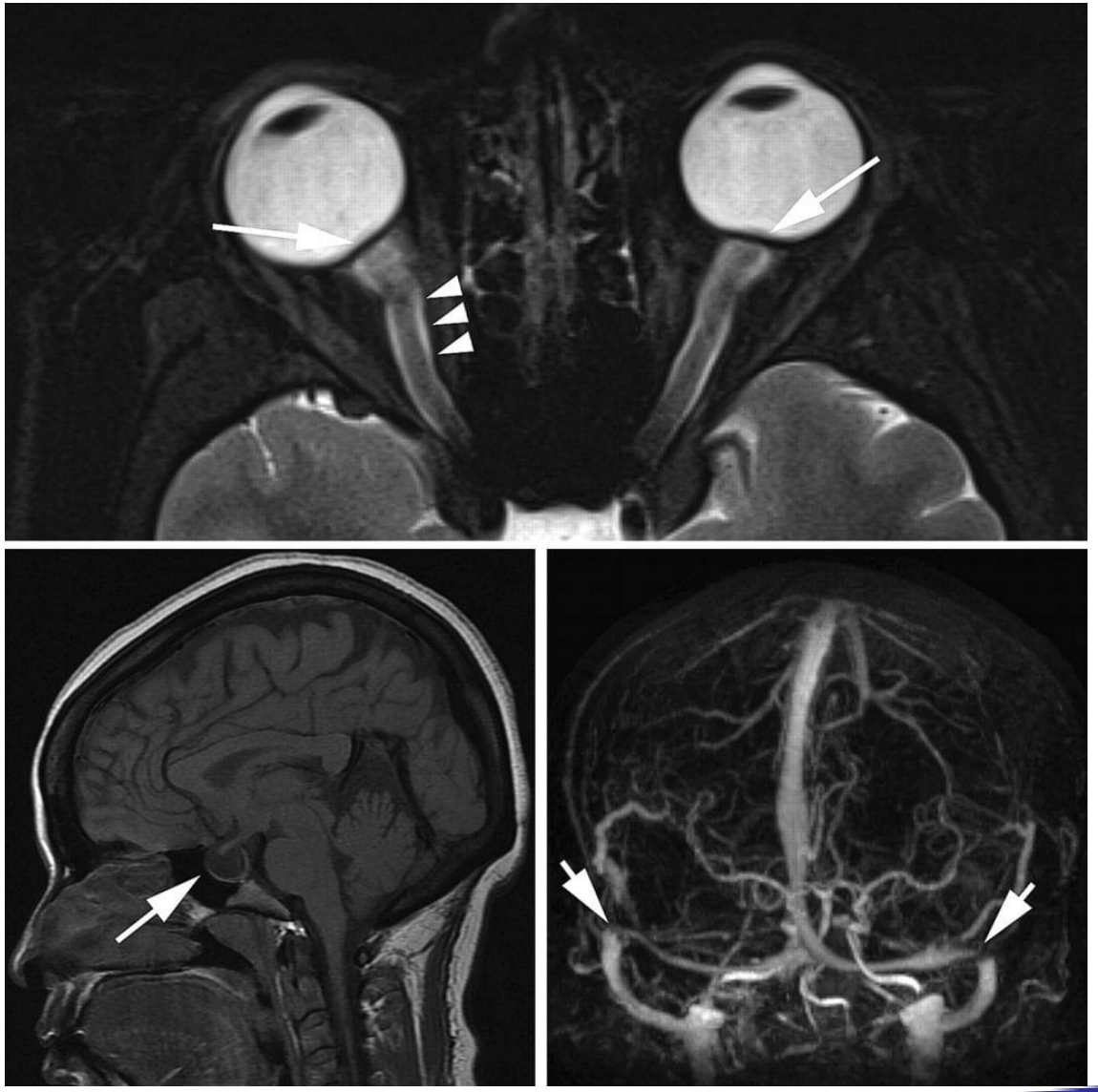


A patient with IIH

- ❑ Empty sella
- ❑ Flattening of posterior globe/sclera
- ❑ Distention of CSF space around optic nerves
- ❑ Bilateral distal TS stenosis



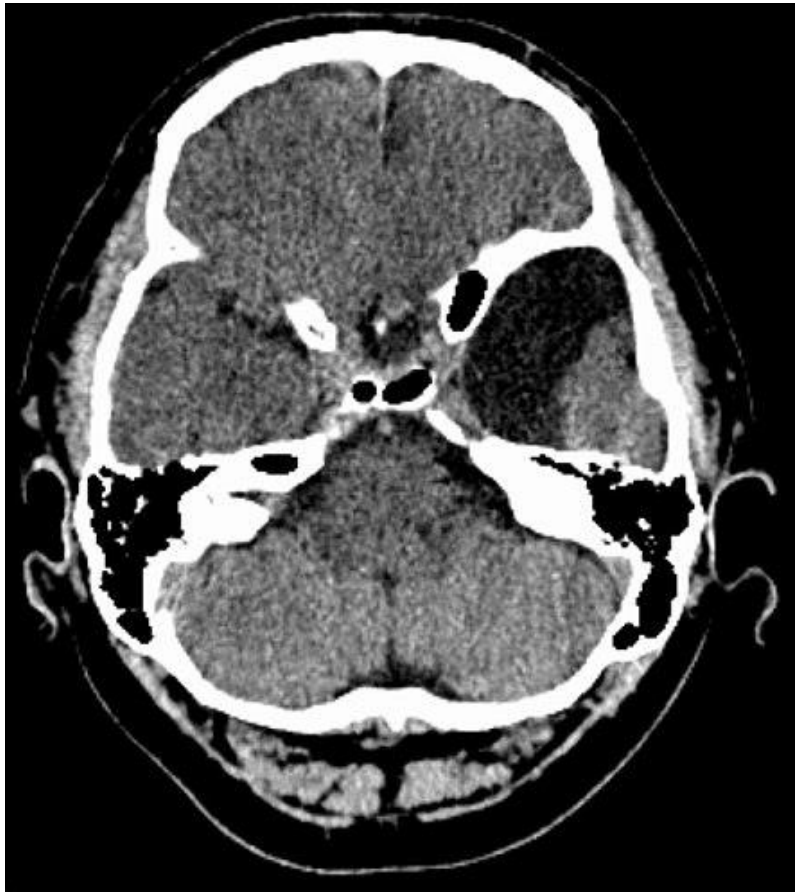
- **A 41-year-old woman with intractable headache and occasional blurred vision.**
- No papilledema/6th nerve palsy.
- MRI shows 3-4 MRI markers for IIH.



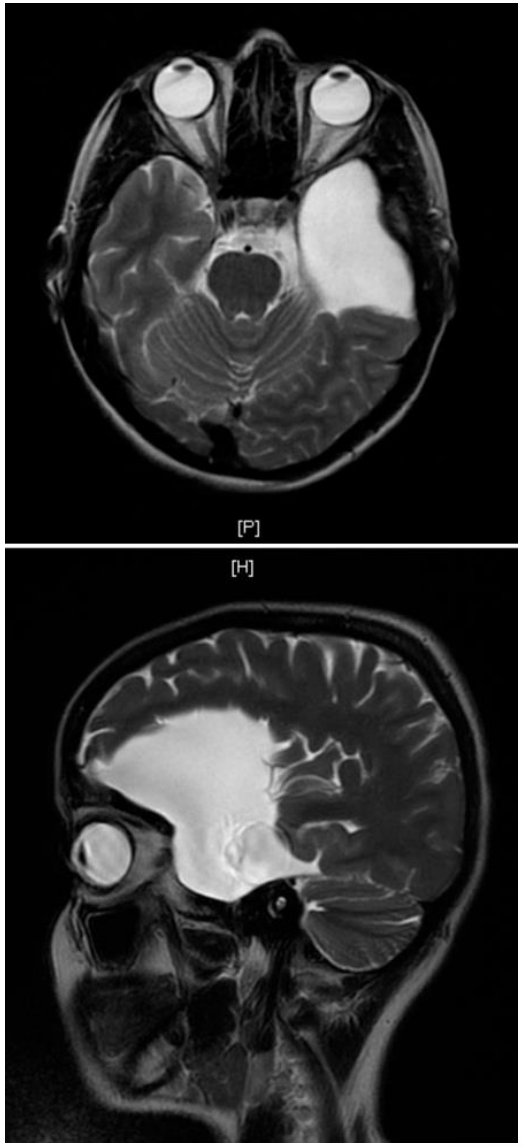
5

A patient with headache and arachnoid cyst.
Is it a secondary headache?

Is it the cause for headache?



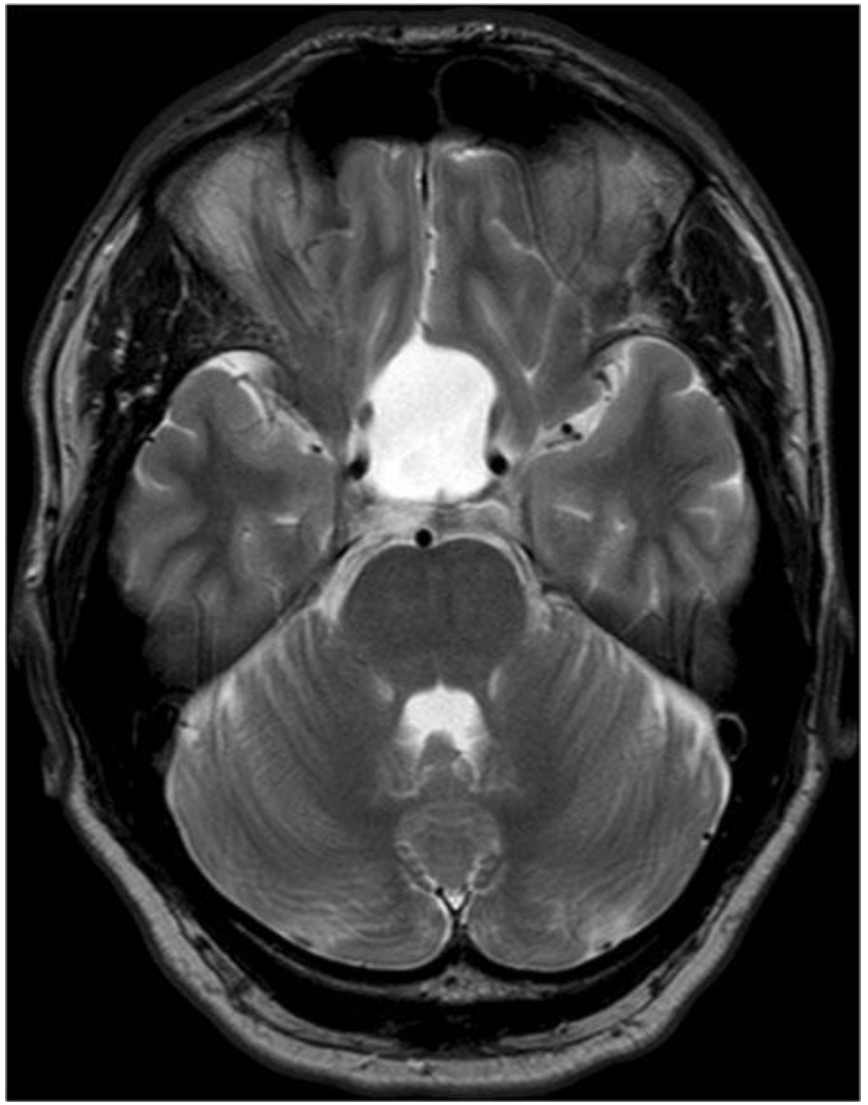
An MRI of a 25-year-old woman with increasing left sided headache .



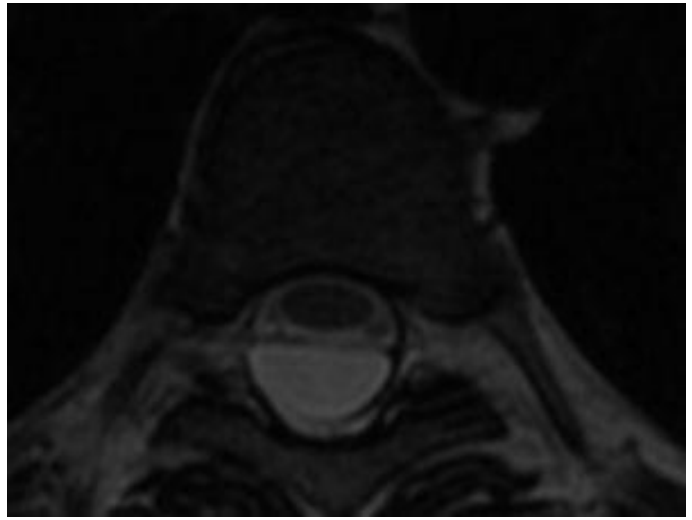
- A 43-year-old male with a 2-month H/O side-locked

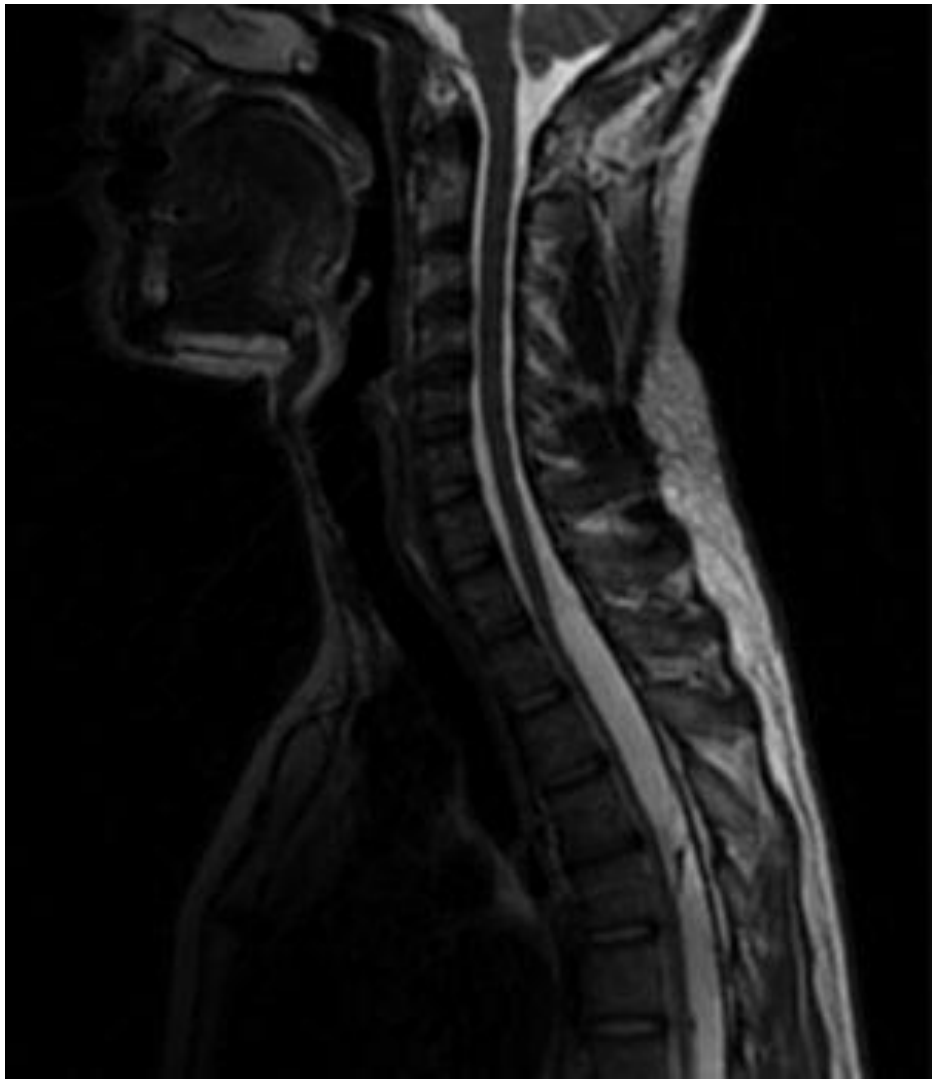
attacks of pain located in the left orbit.

- He satisfied the ICHD-3 criteria for cluster headache.
- The patient responded to symptomatic treatment, but recurred again.
- After operation, the headache attacks resolved completely.



- 39-year old man with a history of episodes of LBP w/o sciatica for several years.
- A **5-month H/O headaches when bending down or performing Valsalva maneuvers**, starting in the occipital region and radiating to the vertex for a few minutes.
- No nausea, vomiting, or visual disturbances.
- General and neurological examinations are normal.





6

Are there characteristic image signs that guide me to the diagnosis?

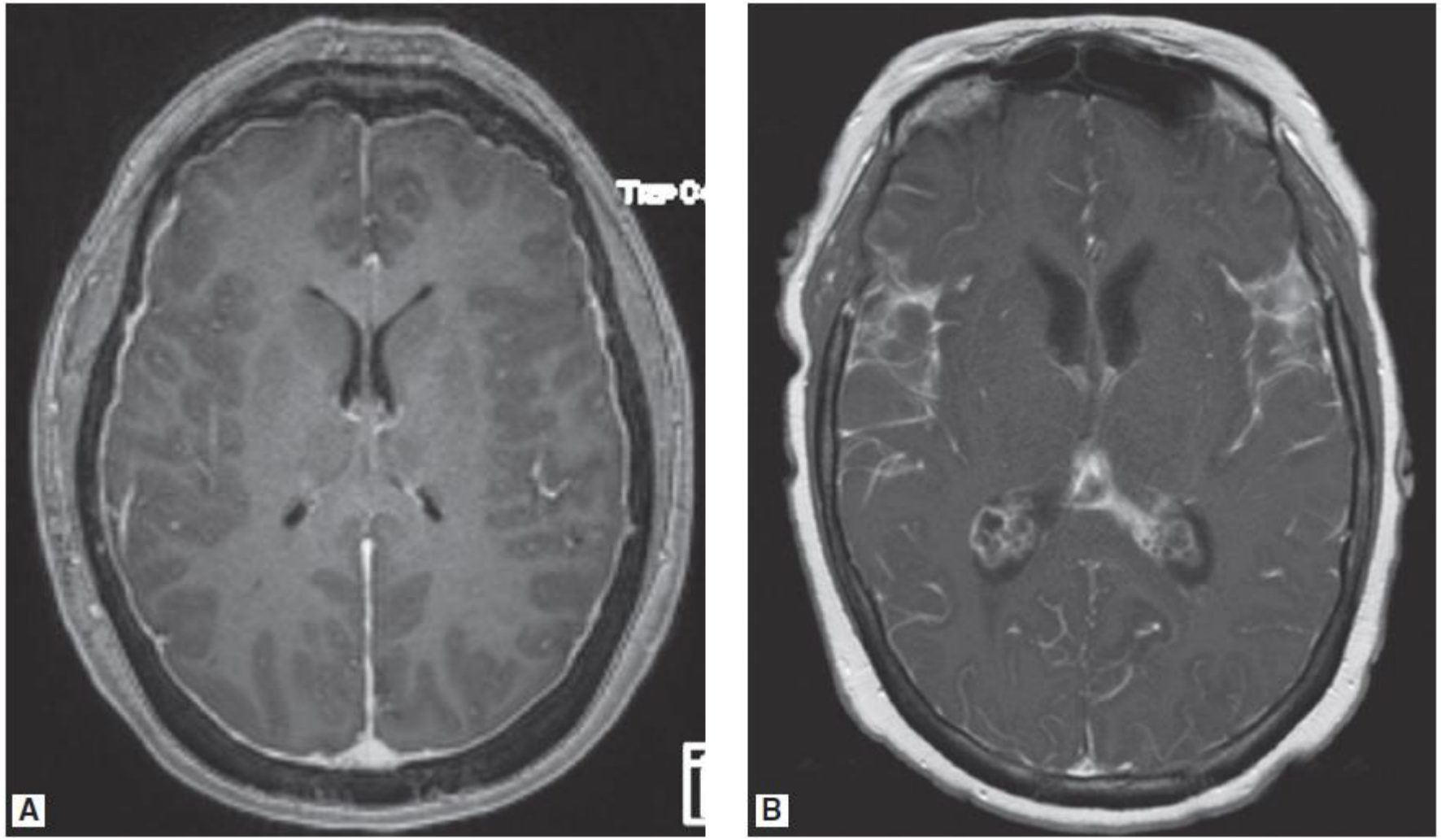
Leptomeningitis VS Pachymeningitis?

Leptomeningeal enhancement

- Follows the contour of the surface of the brain, extending into the cerebral sulci and cerebellar folia.
- Most commonly due to infectious meningitis or malignant > sarcoidosis.

Pachymeningeal enhancement

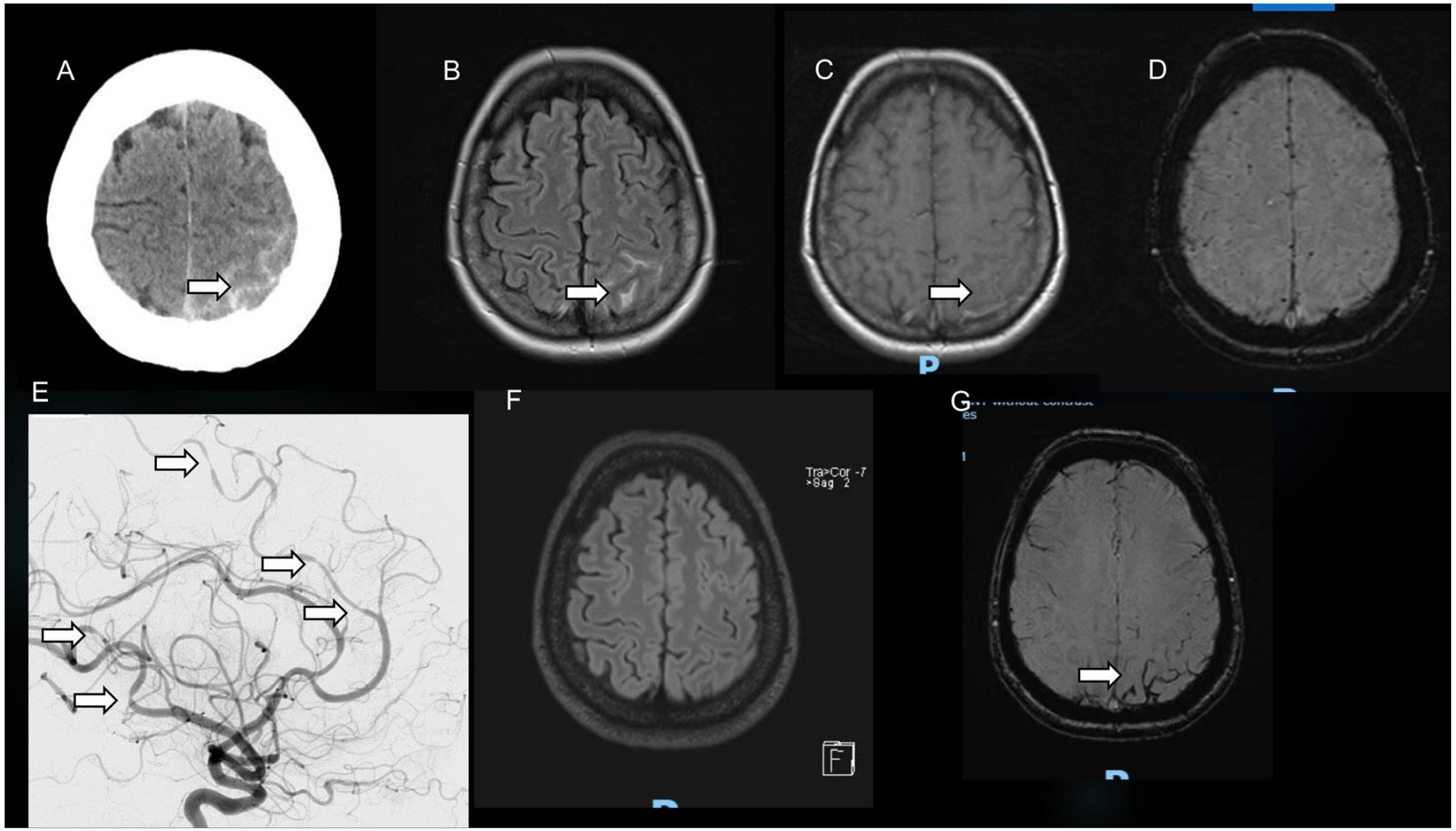
- appears as a rim around the outer surface of the brain *without* invaginating into the sulci; it often involves other dural structures such as the falx and the tentorium.
- Most commonly due to inflammatory disease, tumor, or intracranial hypotension (Smooth & uniform in the latter); though infections (TB, fungi, syphilis) could be the cause.



A: Pachymeningeal enhancement caused by RA.
B: Leptomeningeal enhancement in bacterial meningitis.

Convexity SAH

- A young patient with single or recurrent TCH?
- A patient with vasogenic edema of posterior parts of brain?
- A patient with HA & seizures or focal neuro deficit?
- Older than 60 with transient focal neurologic episodes?

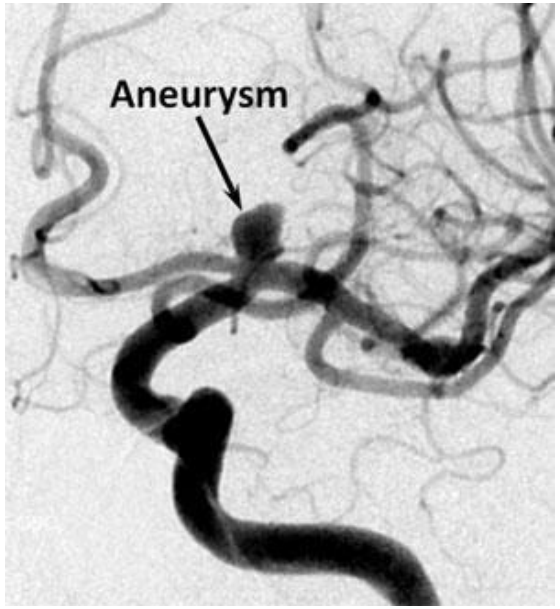


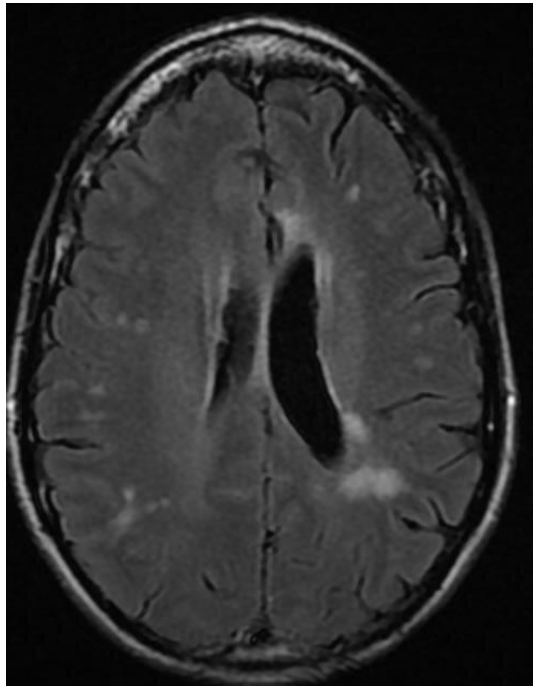
42-year-old woman developed a thunderclap headache while straining in the toilet. She uses Marijuana.

7

A patient with HA and unusual MRI finding. Is it incidental?

Incidentaloma in patients with headache





- Pineal cysts
- Other cysts
- Meningioma
- Empty sella
- Cavernous angioma/DVA
- SVD

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