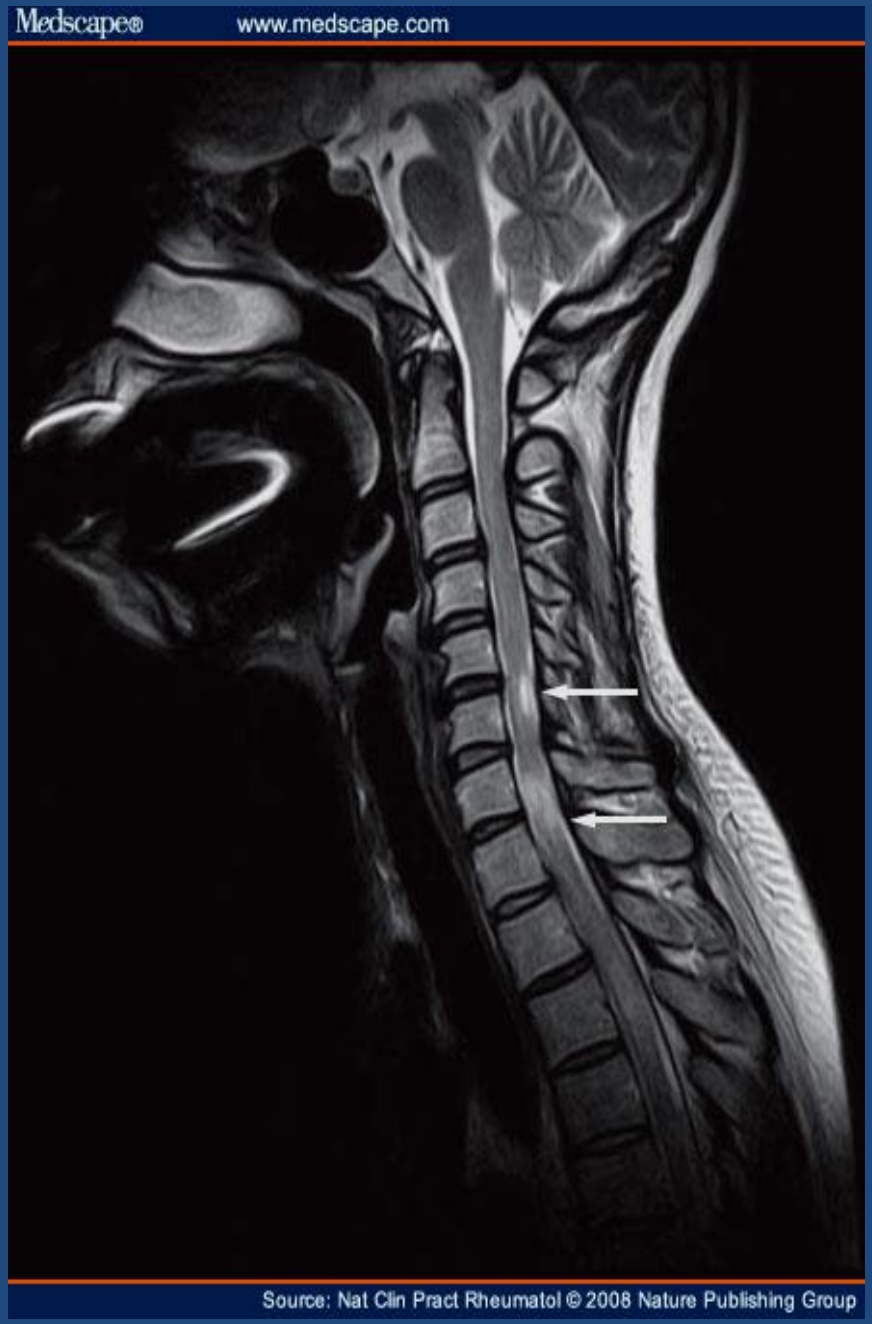
Differential Diagnosis Of MS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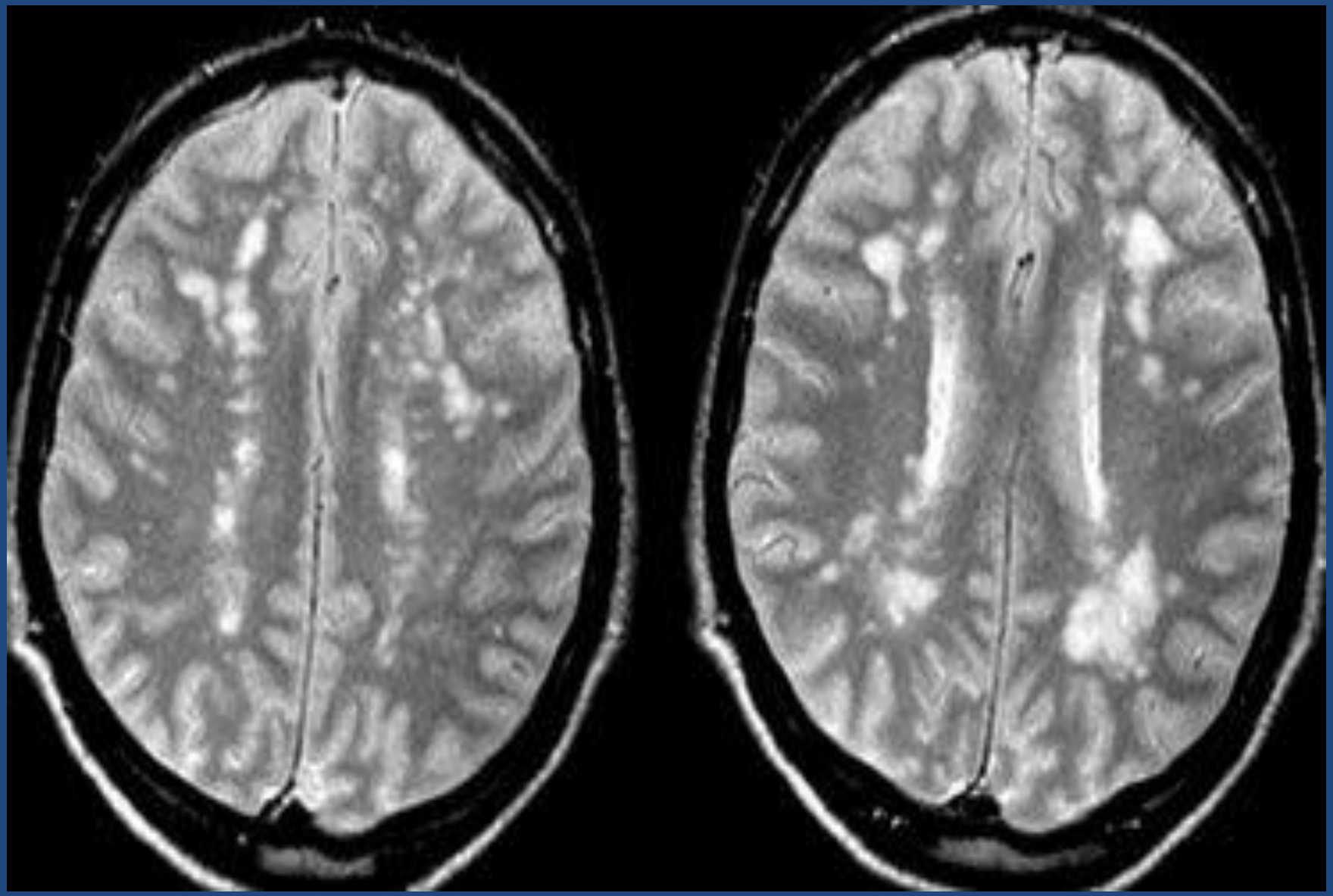

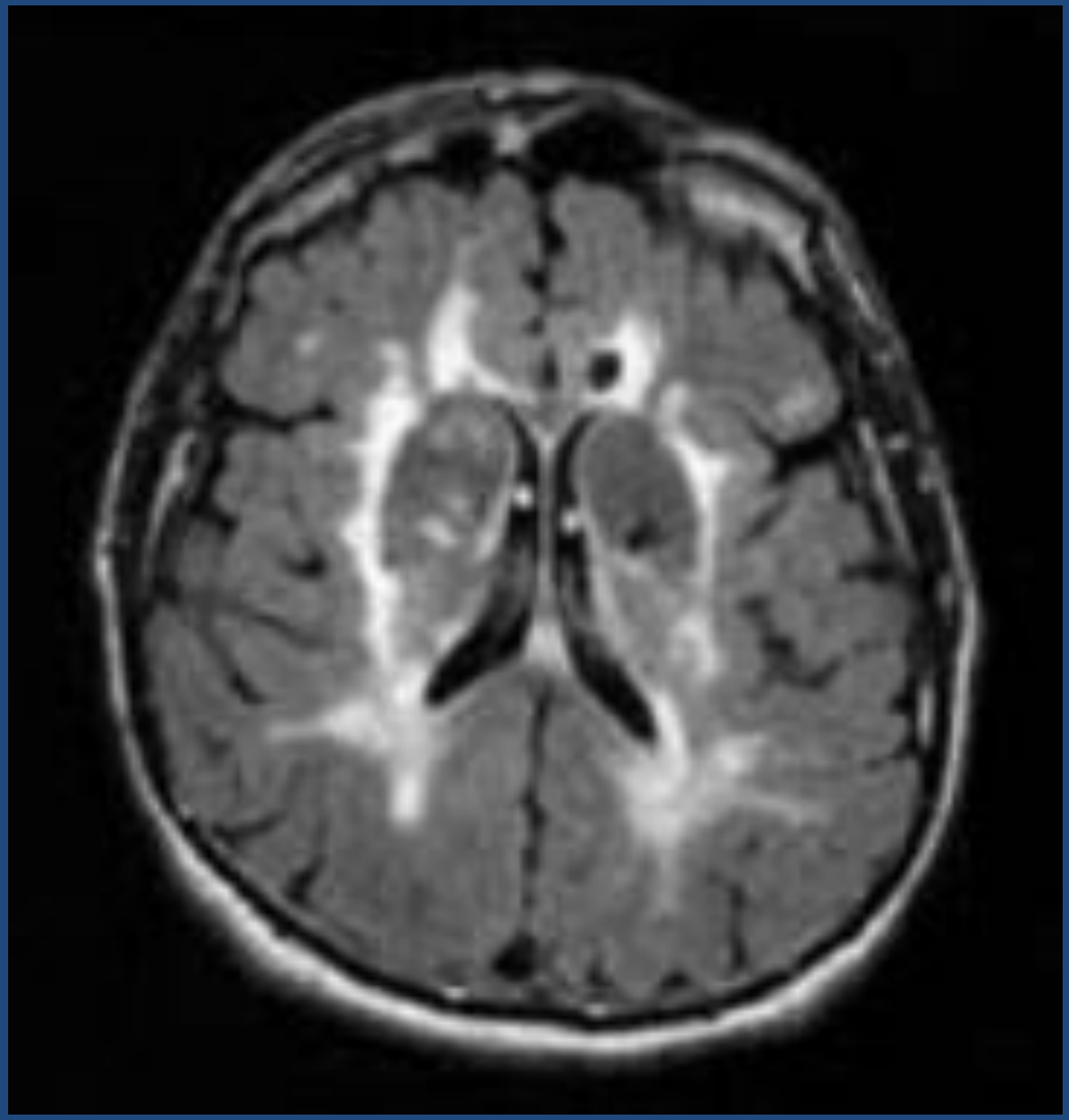

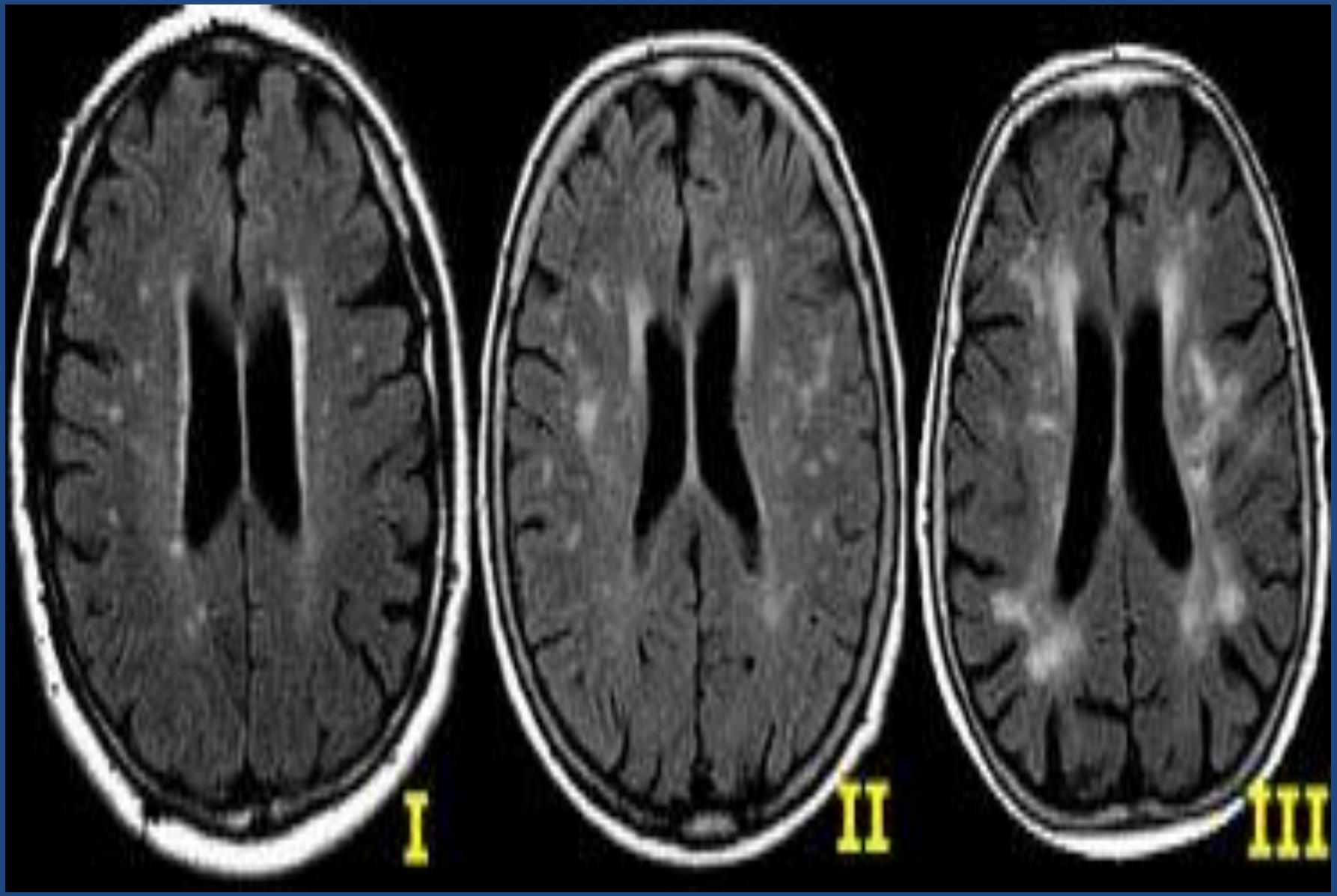
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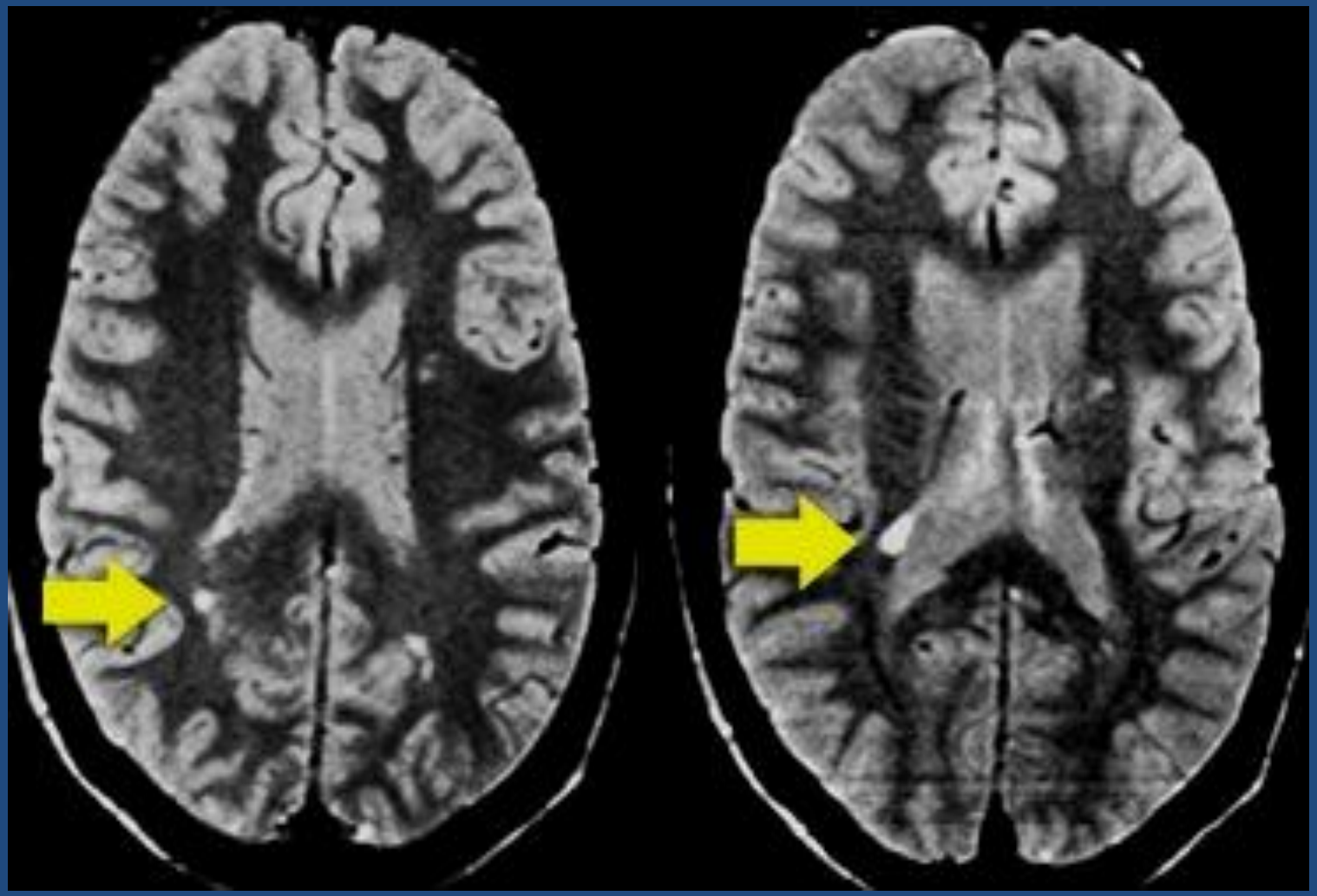

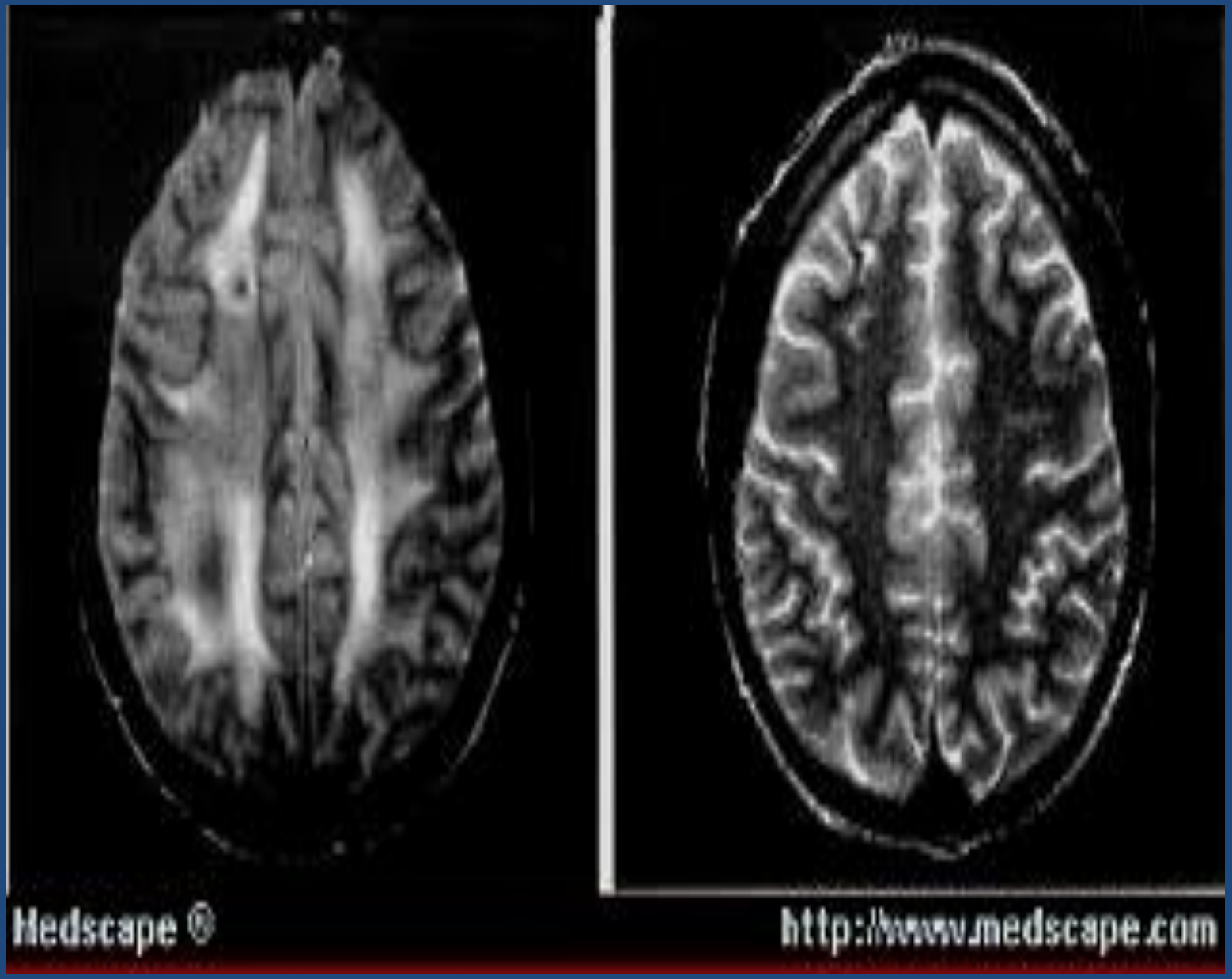
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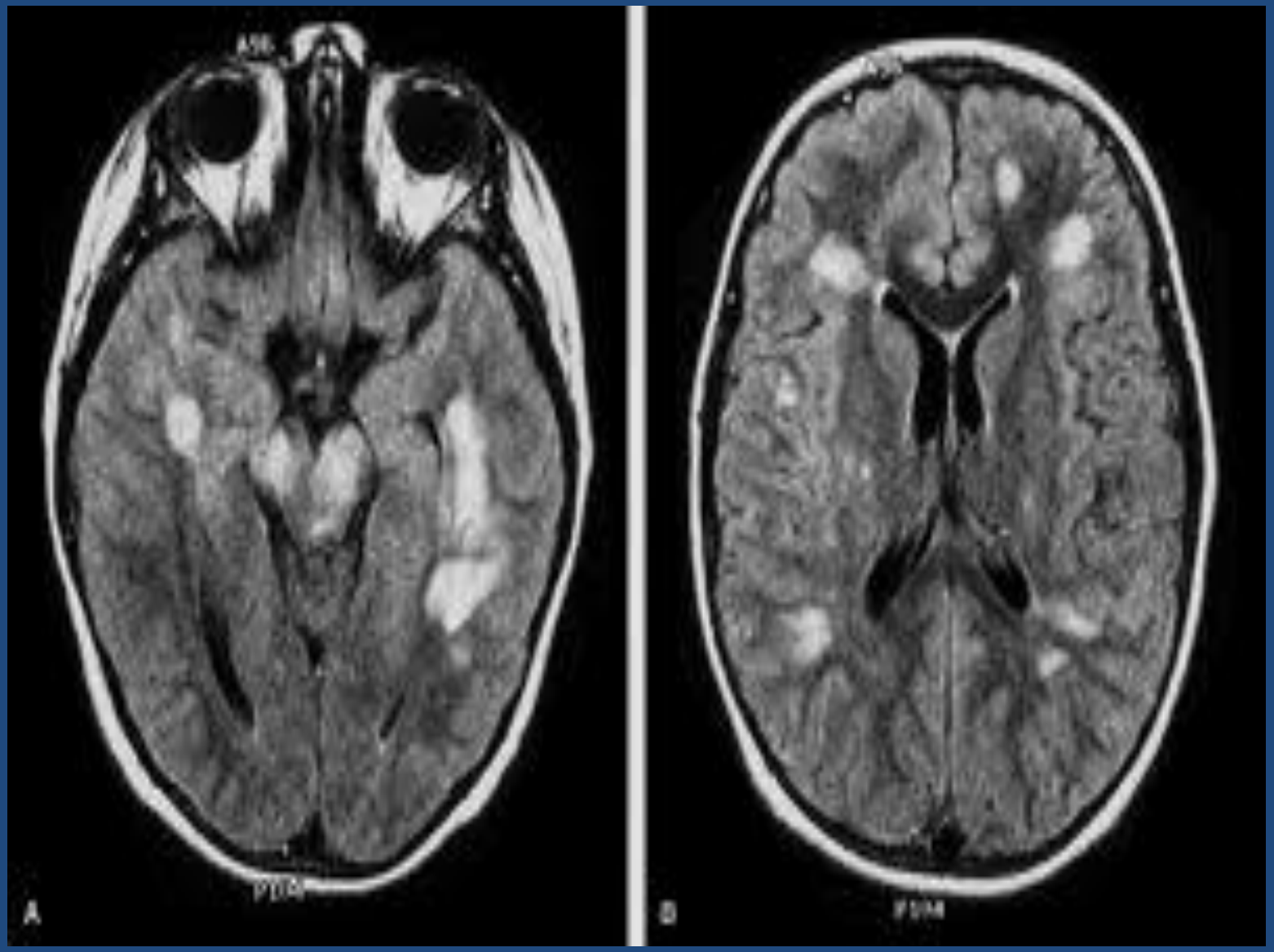
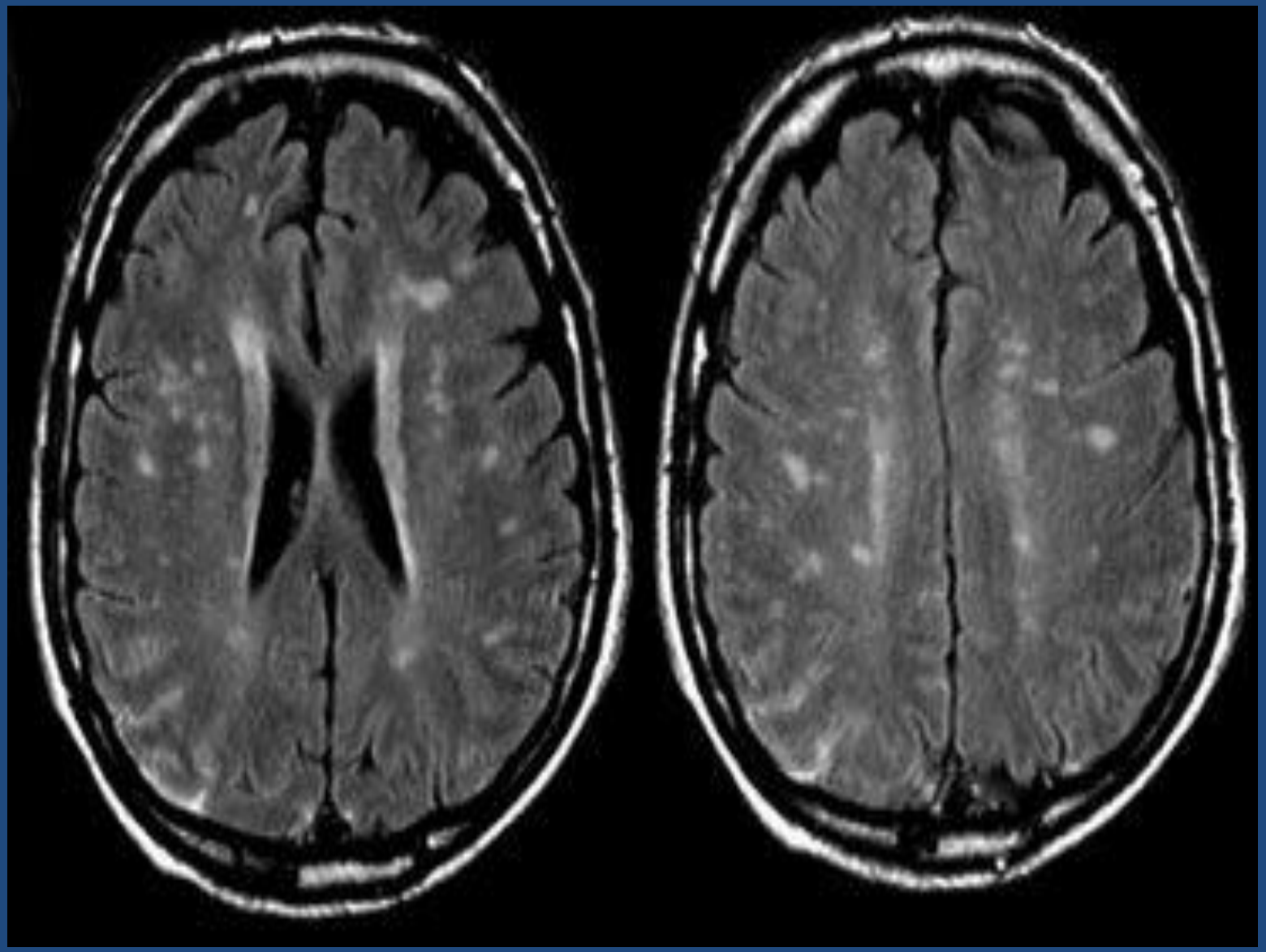

A
B



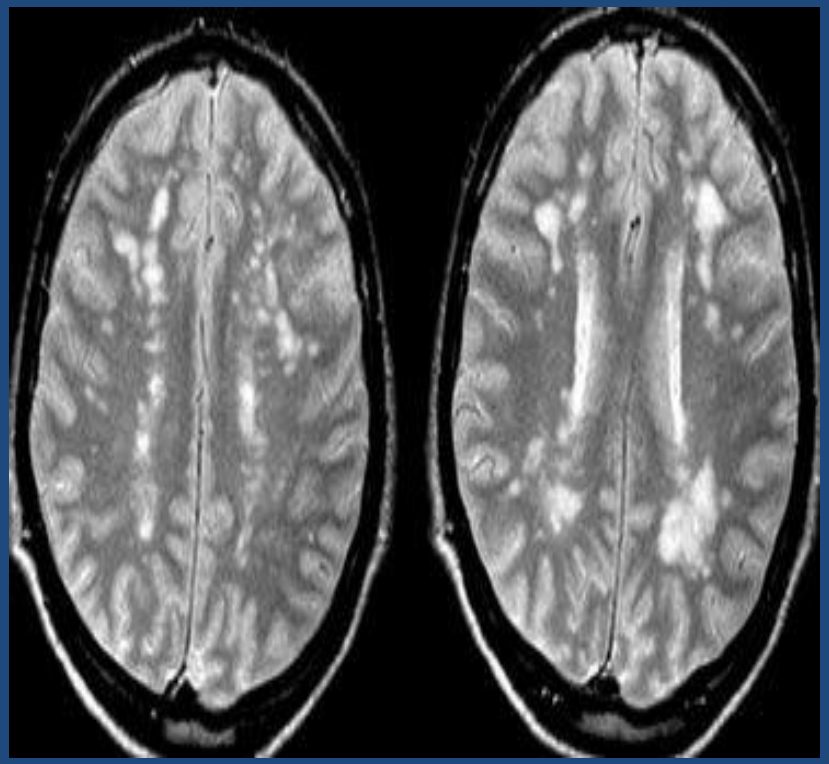
WMLs differential diagnosis

Hypoxic/ischemic	Atherosclerosis, hyperhomocysteinaemia Amyloid angiopathy Diabetic microangiopathy, Hypertension, hyperhomocysteinaemia migraine
Inflammation	MS Vasculitis: SLE, M. Behcet, Sjögren, sarcoid, Inflammatory bowel disease (Crohn, colitis ulcerosa, coeliakie)
Infectious	HIV, syphilis, Lyme (borreliose), PML: progressive multifocal leuken-cephalopathy postinfectious: ADEM
Toxic/metabolic	CO-intoxication, B12 deficiency Central pontine myelinolysis
Traumatic	Radiotherapy Postcontusion
Hereditary	Metabolic (symmetrical, dd:toxic)
Normal	VR-spaces, Fazekas I

Multiple Sclerosis

- Multiple Sclerosis(MS) is the most common inflammatory demyelinating disease of CNS in young and middle-age adults , but also affects old people
- According to Mc Donald criteria for MS the diagnosis requires objective evidence of lesions disseminated in time and space
- As a consequence there is an important role for MRI in the diagnosis of MS ,since MRI can show multiple lesions (dissemination in space),some of which can be clinically occult and MRI can show new lesions on follow up scans (dissemination in time)

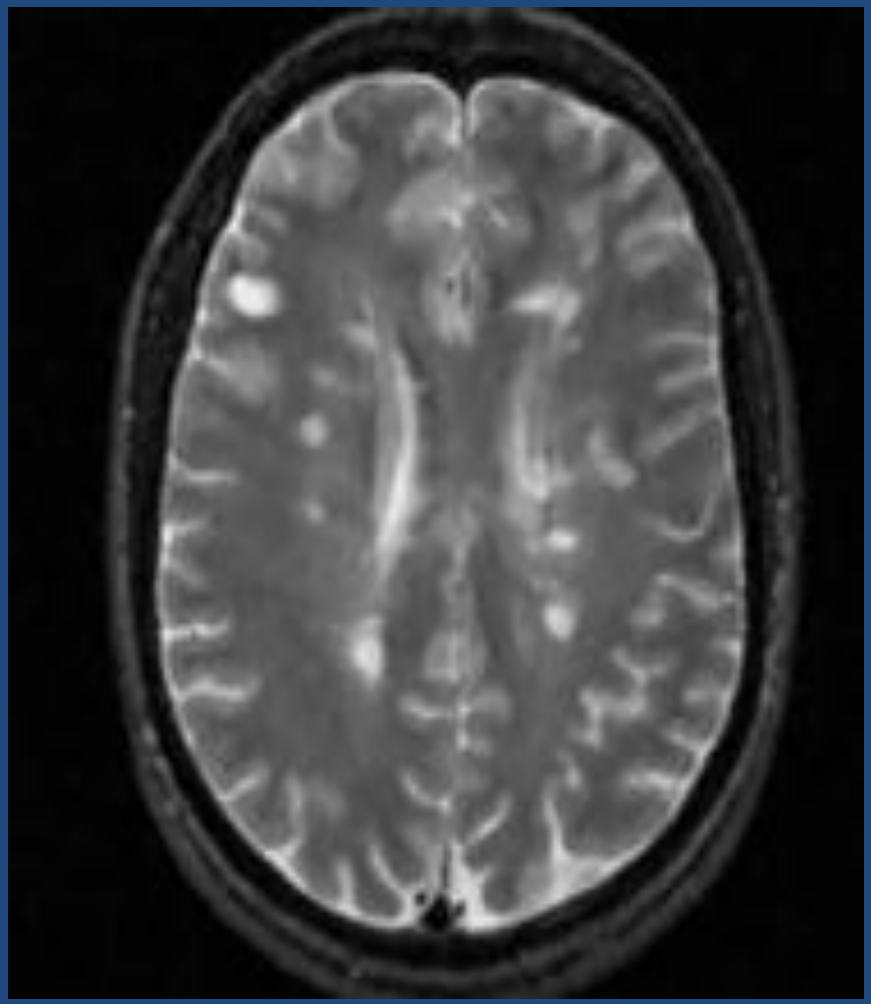
Multiple Sclerosis ?



- Many neurologic disease can mimic MS both clinically and radiologically
- Most incidentally found WMLs will have vascular origin
- The list of possible diagnose of WMLs is long

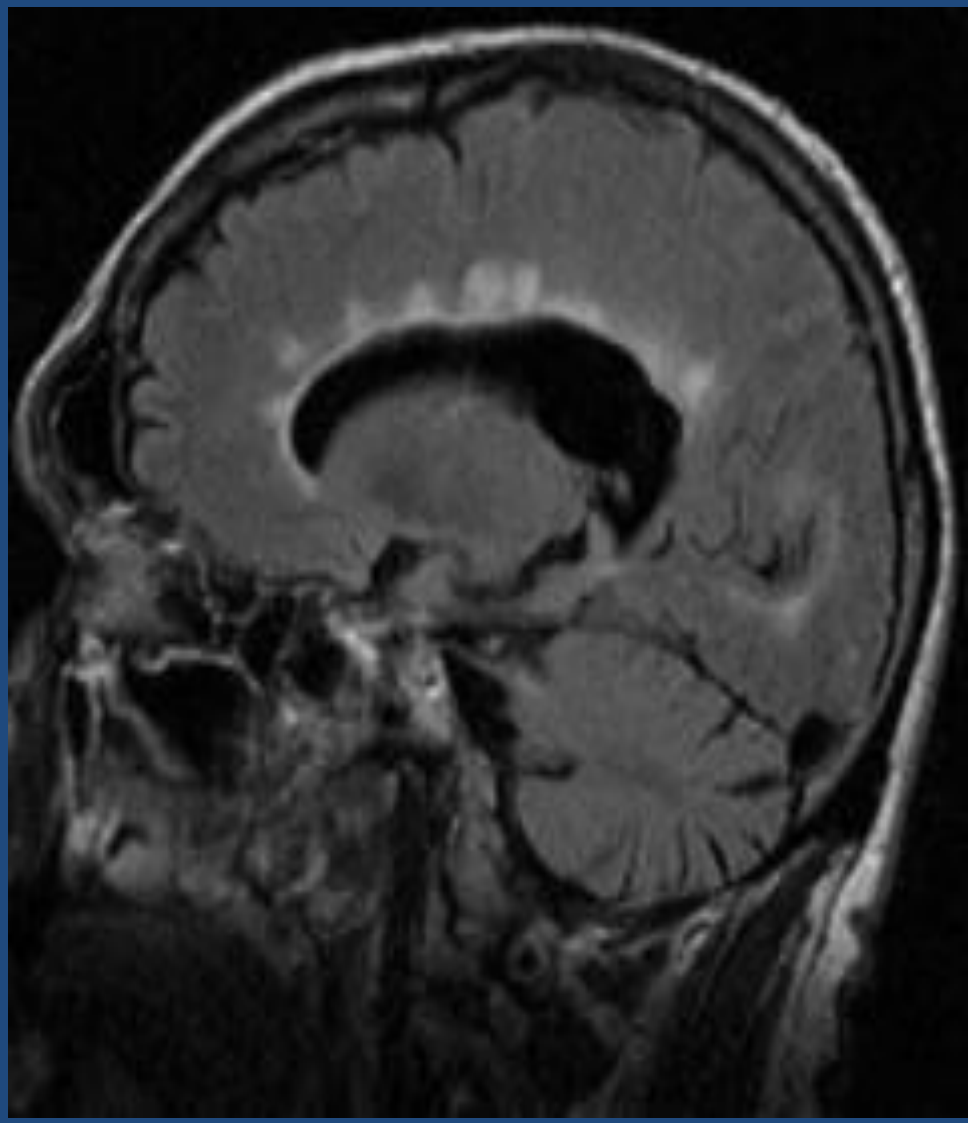
MS(CONT)

Typical MRI finding in MS is involvement of corpus callosum,u fibers,temporal lobes,brain stem , cerebellum and spinal cord



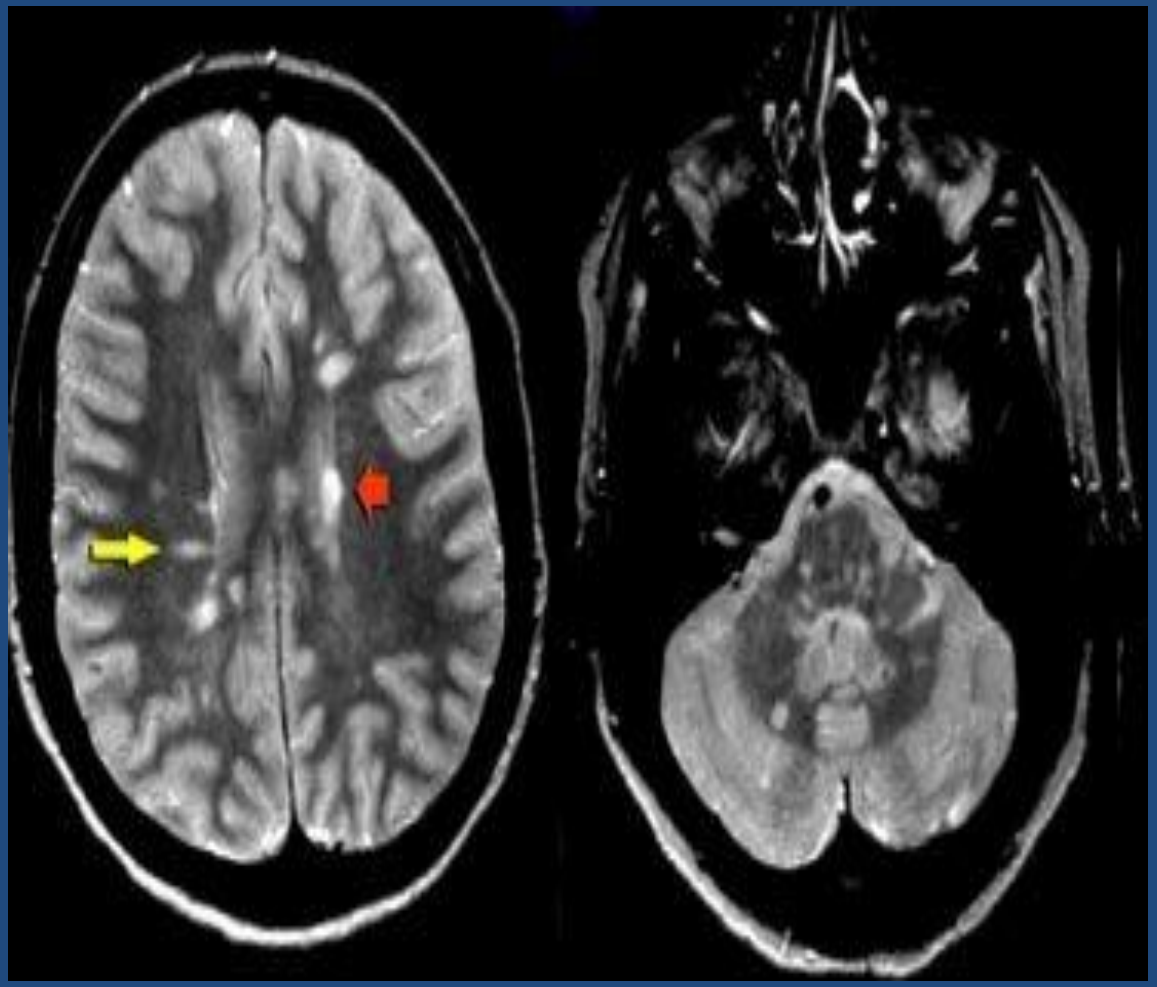
MS (cont)

This pattern of involvement is uncommon in other disease



MS (CONT)

Look at the image and look for lesions that are specific for MS

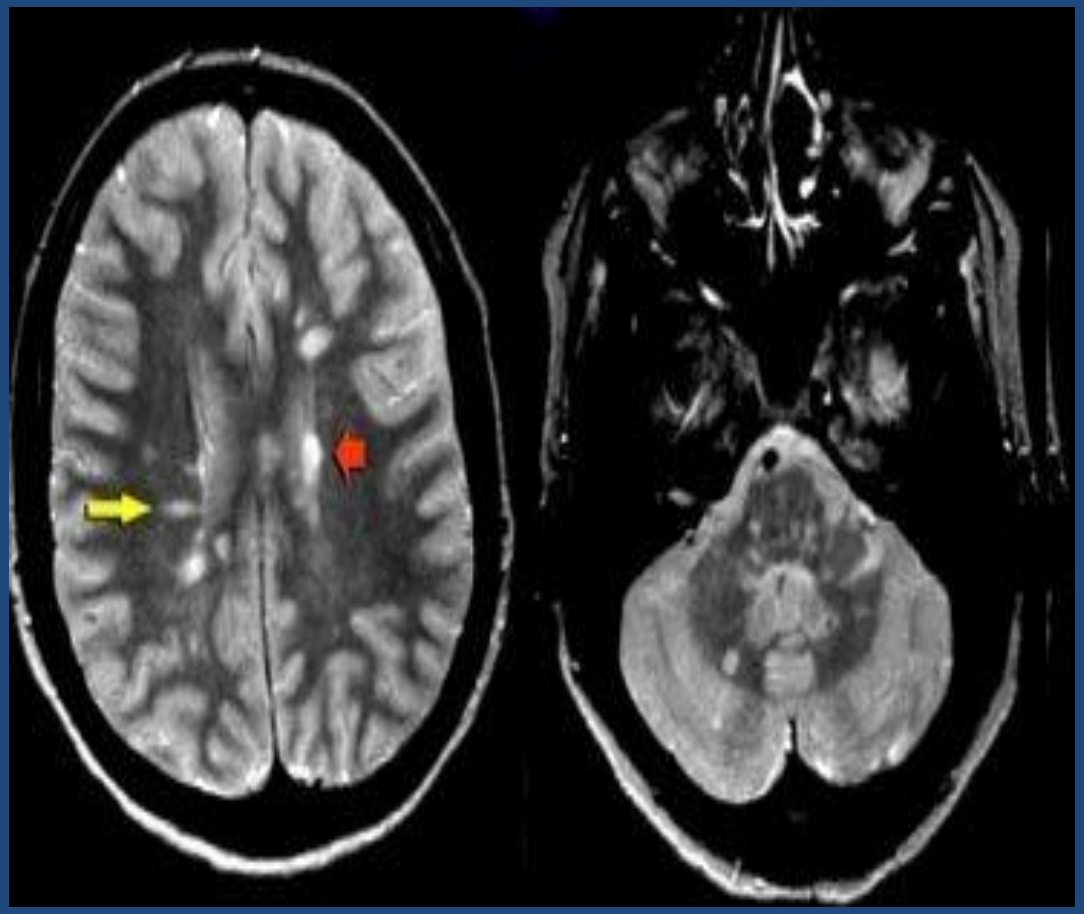


MS(cont)

Multiple lesions adjacent to the ventricles(red arrow)

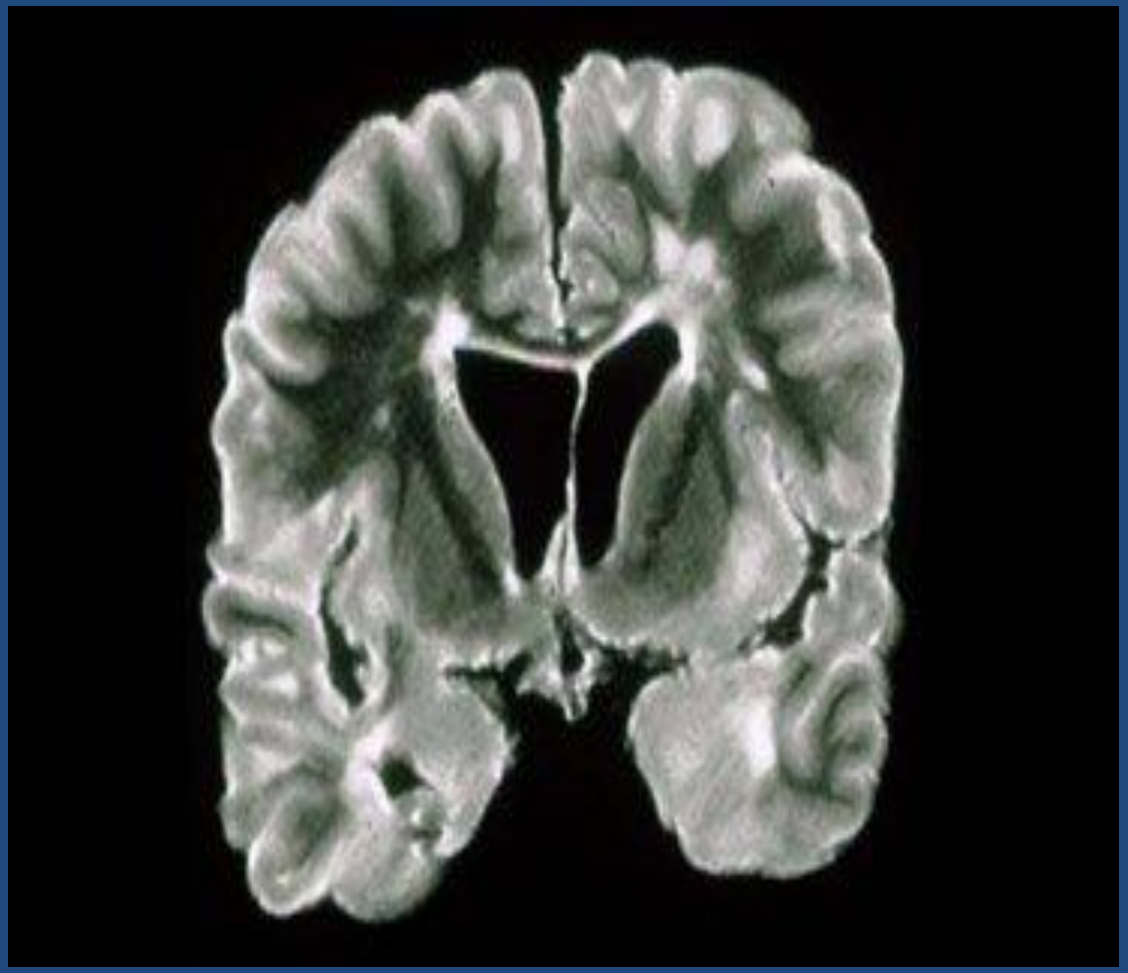
Ovoid lesions perpendicular to the ventricles (yellow arrow)

Multiple lesions in brain stem and cerebellum



MS(CONT)

Look at the image and look for lesions that are specific for MS



MS(CONT)

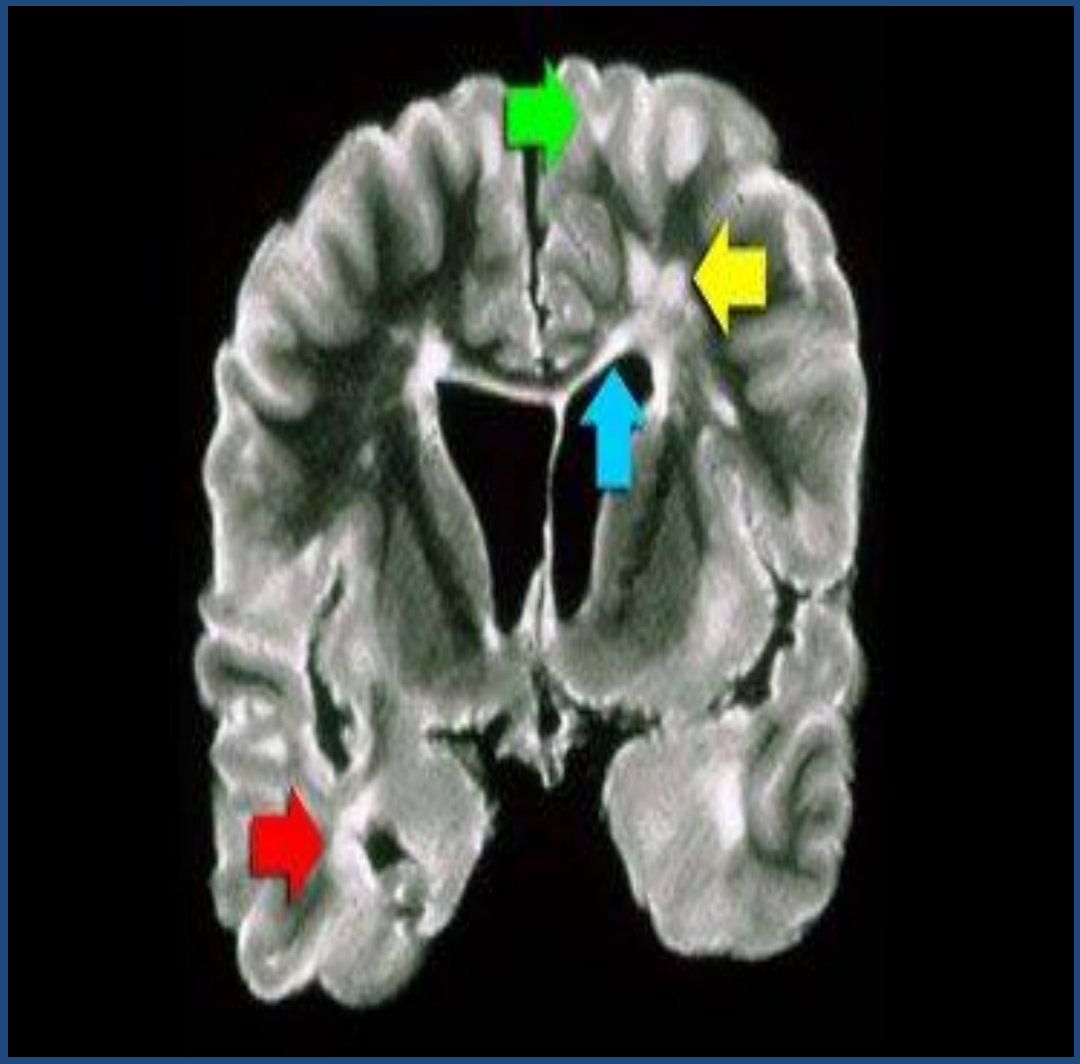
Deep white matter(yellow)

Temporal lobe(red)

Juxtacortical (green)

Periventricular

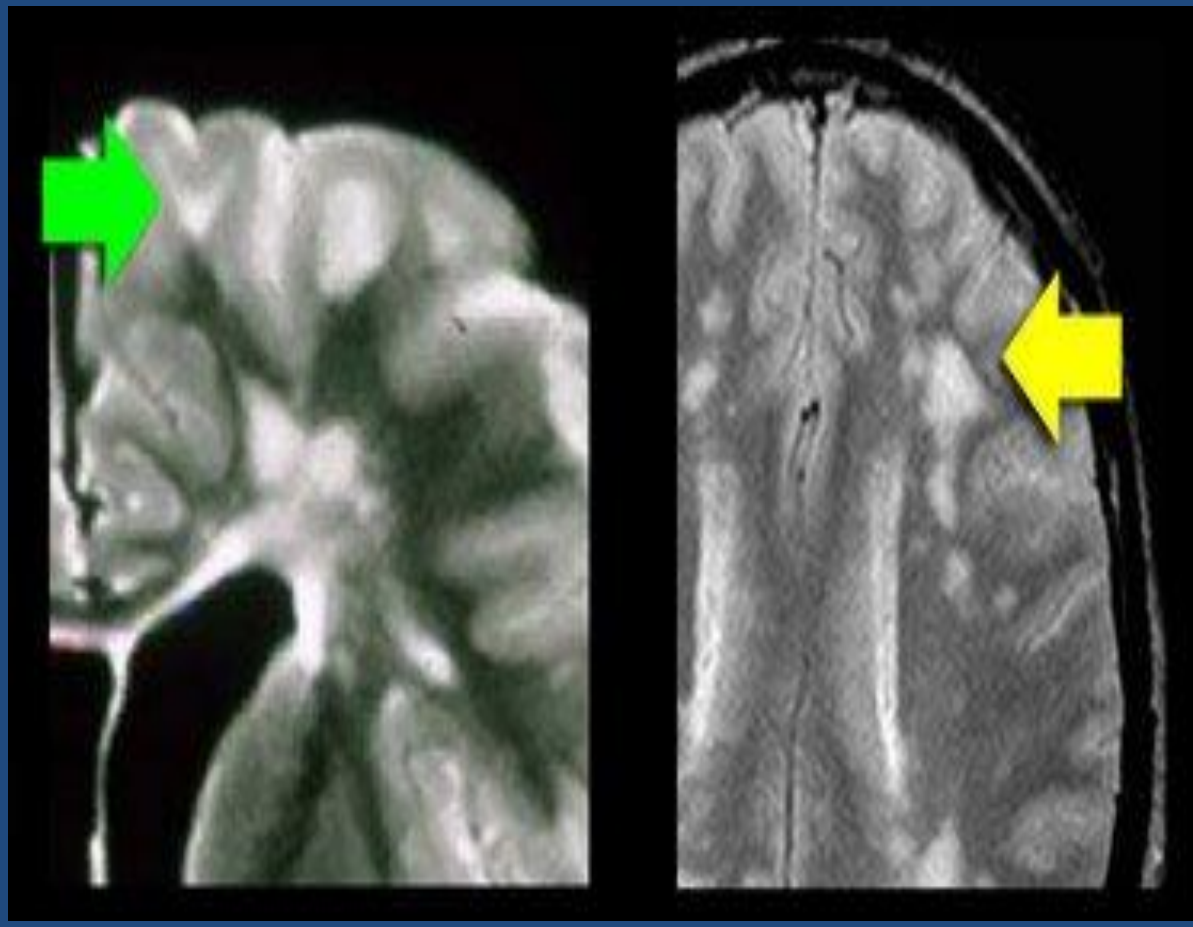
Corpus callosum (blue)



MS(CONT)

Involvement of u-fiber in MS (green arrow)

U-fiber are not involved in patients with hypertension (yellow arrow)

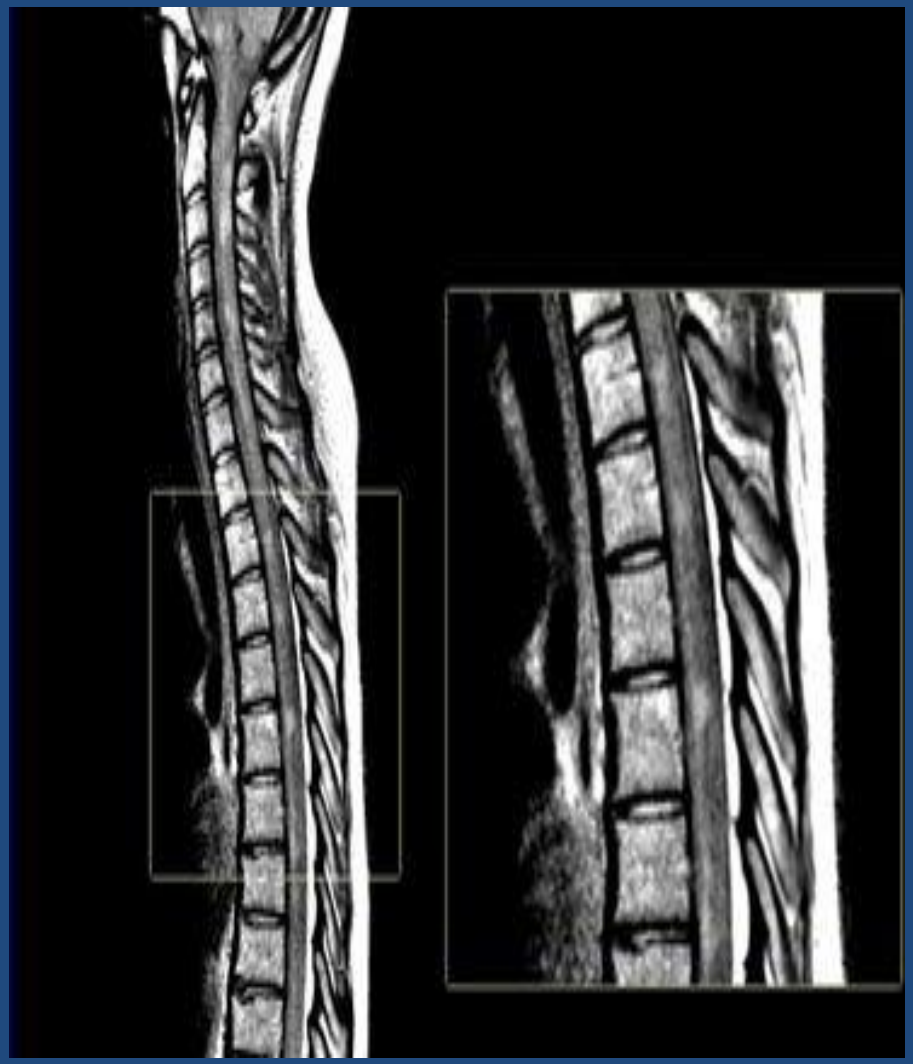


MS (CONT)

Spinal cord lesion is another typical feature of MS

A spinal cord lesion together with a lesion in the cerebellum or brain stem is very suggestive of MS

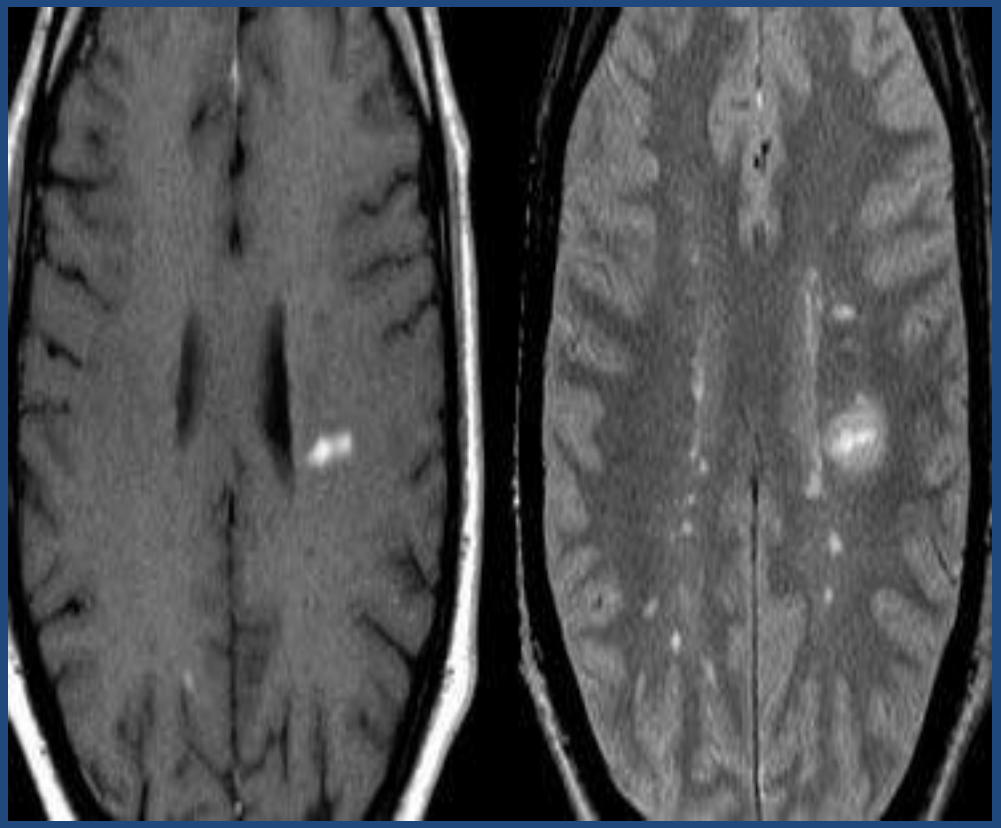
Spinal cord lesions are uncommon in most other CNS disease with exception of SLE , Sarcoid , Lyme and ADEM



MS(cont)

- Ovoid lesions perpendicular to the ventricle(Dawson finger)
- Enhancing lesion
- Multiple lesions adjacent to the ventricles

Dawson fingers are typical for MS and are the result of inflammation around penetrating venules

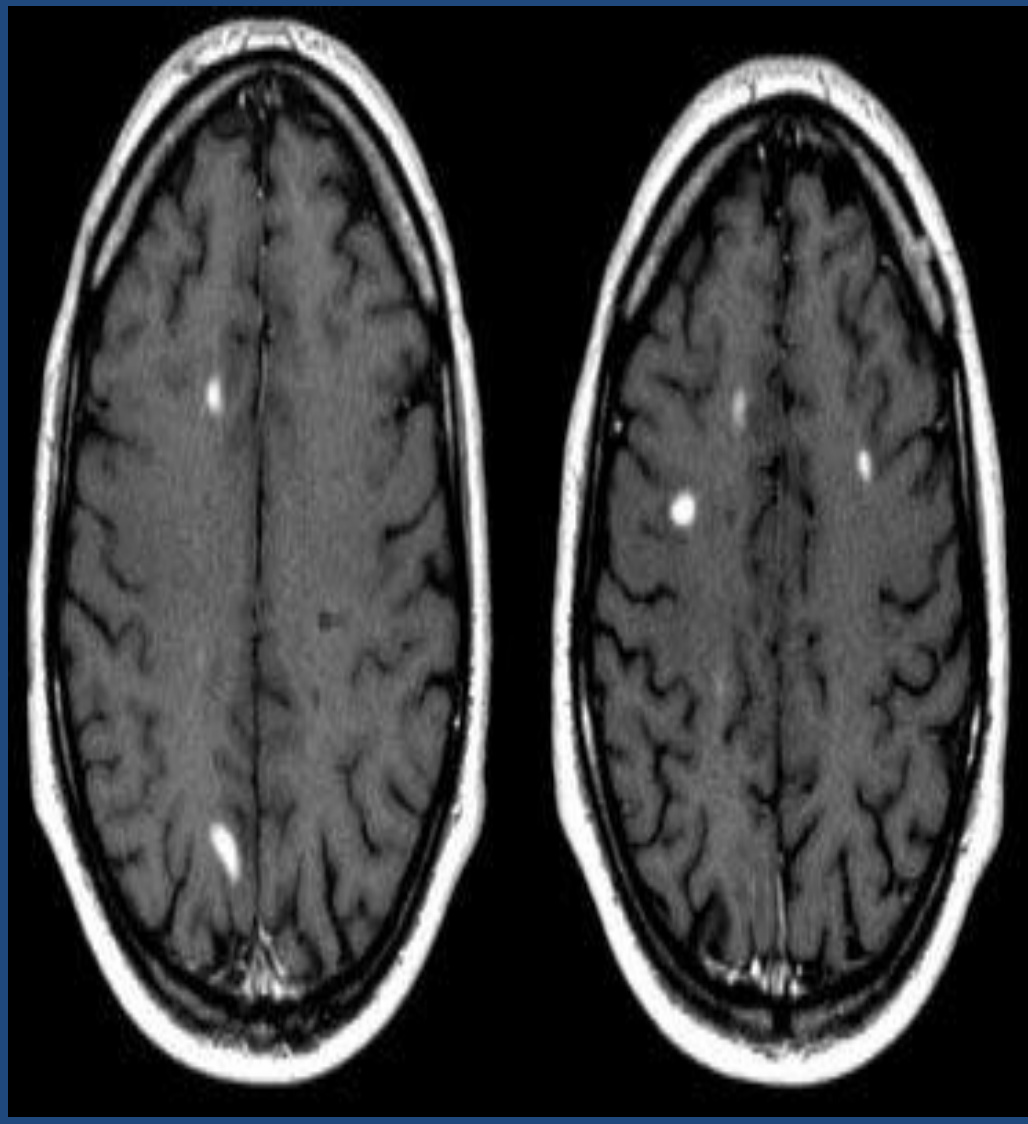


MS(cont)

Enhancement is another typical finding in MS.

Enhancement will be present for about one month after occurrence of a lesion

The simultaneous demonstration of enhancing and non-enhancing lesions in is the radiological counterpart of the clinical dissemination in time and space

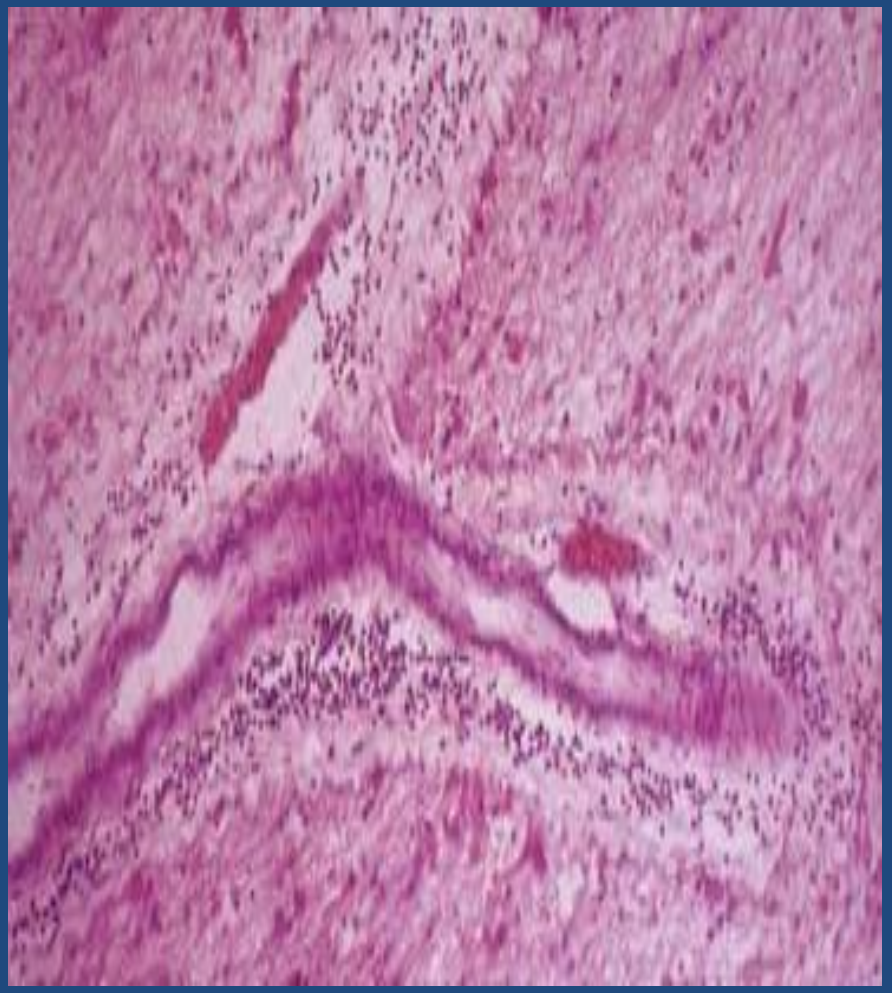


MS(cont)

Perivenous inflammation in MS starts as inflammation around these veins.

In the first four weeks of the inflammation there is enhancement with GD due to loss of BBB

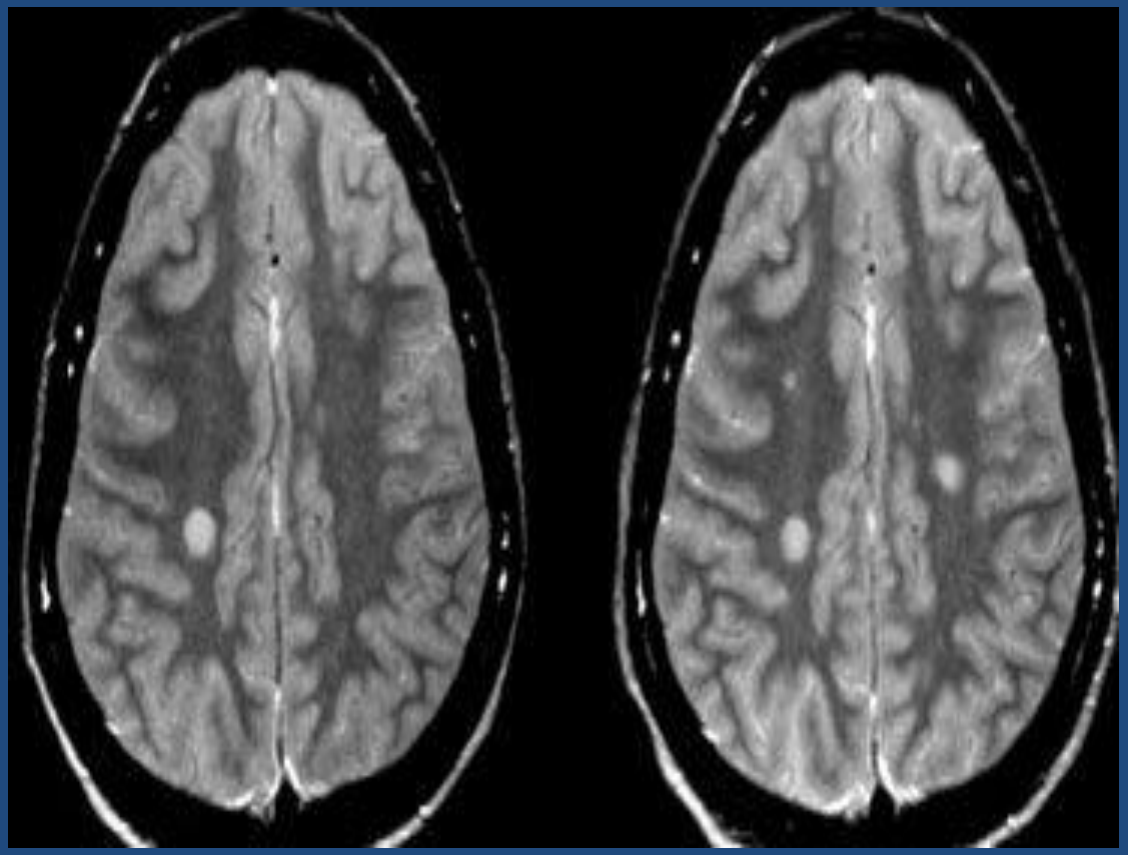
First enhancement is homogenous but can change to ring enhancement



MS(cont)

LEFT: Single lesion on T2WI

RIGHT : Two new lesions at 3 month follow up



DIS Can Be Demonstrated by ≥1 T2 Lesion[a] in at Least 2 of 4 Areas of the CNS:

Periventricular
Juxtacortical
Infratentorial
Spinal cord[b]

Based on Swanton et al 2006, 2007.[22,27]

[a]Gadolinium enhancement of lesions is not required for DIS.

[b]If a subject has a brainstem or spinal cord syndrome, the symptomatic lesions are excluded from the Criteria and do not contribute to lesion count.

MRI = magnetic resonance imaging; DIS = lesion dissemination in space; CNS = central nervous system.

DIT Can Be Demonstrated by:

1. A new T2 and/or gadolinium-enhancing lesion(s) on follow-up MRI, with reference to a baseline scan, irrespective of the timing of the baseline MRI
2. Simultaneous presence of asymptomatic gadolinium-enhancing and nonenhancing lesions at any time

Based on Montalban et al 2010.[24]

MRI = magnetic resonance imaging; DIT = lesion dissemination in time.

Clinical Presentation	Additional Data Needed for MS Diagnosis
≥2 attacks[a]; objective clinical evidence of ≥2 lesions or objective clinical evidence of 1 lesion with reasonable historical evidence of a prior attack[b]	None[c]
≥2 attacks[a]; objective clinical evidence of 1 lesion	Dissemination in space, demonstrated by: ≥1 T2 lesion in at least 2 of 4 MS-typical regions of the CNS (periventricular, juxtacortical, infratentorial, or spinal cord)[d]; or Await a further clinical attack[a] implicating a different CNS site
1 attack[a]; objective clinical evidence of ≥2 lesions	Dissemination in time, demonstrated by: Simultaneous presence of asymptomatic gadolinium-enhancing and nonenhancing lesions at any time; or A new T2 and/or gadolinium-enhancing lesion(s) on follow-up MRI, irrespective of its timing with reference to a baseline scan; or Await a second clinical attack[a]
1 attack[a]; objective clinical evidence of 1 lesion (clinically isolated syndrome)	Dissemination in space and time, demonstrated by: For DIS: ≥1 T2 lesion in at least 2 of 4 MS-typical regions of the CNS (periventricular, juxtacortical, infratentorial, or spinal cord)[d]; or Await a second clinical attack[a] implicating a different CNS site; and For DIT: Simultaneous presence of asymptomatic gadolinium-enhancing and nonenhancing lesions at any time; or A new T2 and/or gadolinium-enhancing lesion(s) on follow-up MRI irrespective of its timing with reference to a baseline scan; or Await a second clinical attack[a]
Insidious neurological progression suggestive of MS (PPMS)	1 year of disease progression (retrospectively or prospectively determined) plus 2 of 3 of the following criteria[d]: 1. Evidence for DIS in the brain based on ≥1 T2 lesions in the MS-characteristic (periventricular, juxtacortical, or infratentorial) regi 2. Evidence for DIS in the spinal cord based on ≥2 T2 lesions in the cord 3. Positive CSF (isoelectric focusing evidence of oligoclonal bands and/or elevated IgG index)

If the Criteria are fulfilled and there is no better explanation for the clinical presentation, the diagnosis is "MS"; if suspicious, the Criteria are not completely met, the diagnosis is "possible MS"; if another diagnosis arises during the evaluation that better explains the clinical presentation, then the diagnosis is "not MS."

[a]An attack (relapse; exacerbation) is defined as patient-reported or objectively observed events typical of an acute inflammatory demyelinating event in the CNS, current or historical, with duration of at least 24 hours, in the absence of fever or infection. should be documented by contemporaneous neurological examination, but some historical events with symptoms and evolutio characteristic for MS, but for which no objective neurological findings are documented, can provide reasonable evidence of a p demyelinating event. Reports of paroxysmal symptoms (historical or current) should, however, consist of multiple episodes occ ring over not less than 24 hours. Before a definite diagnosis of MS can be made, at least 1 attack must be corroborated by find on neurological examination, visual evoked potential response in patients reporting prior visual disturbance, or MRI consistent with demyelination in the area of the CNS implicated in the historical report of neurological symptoms.

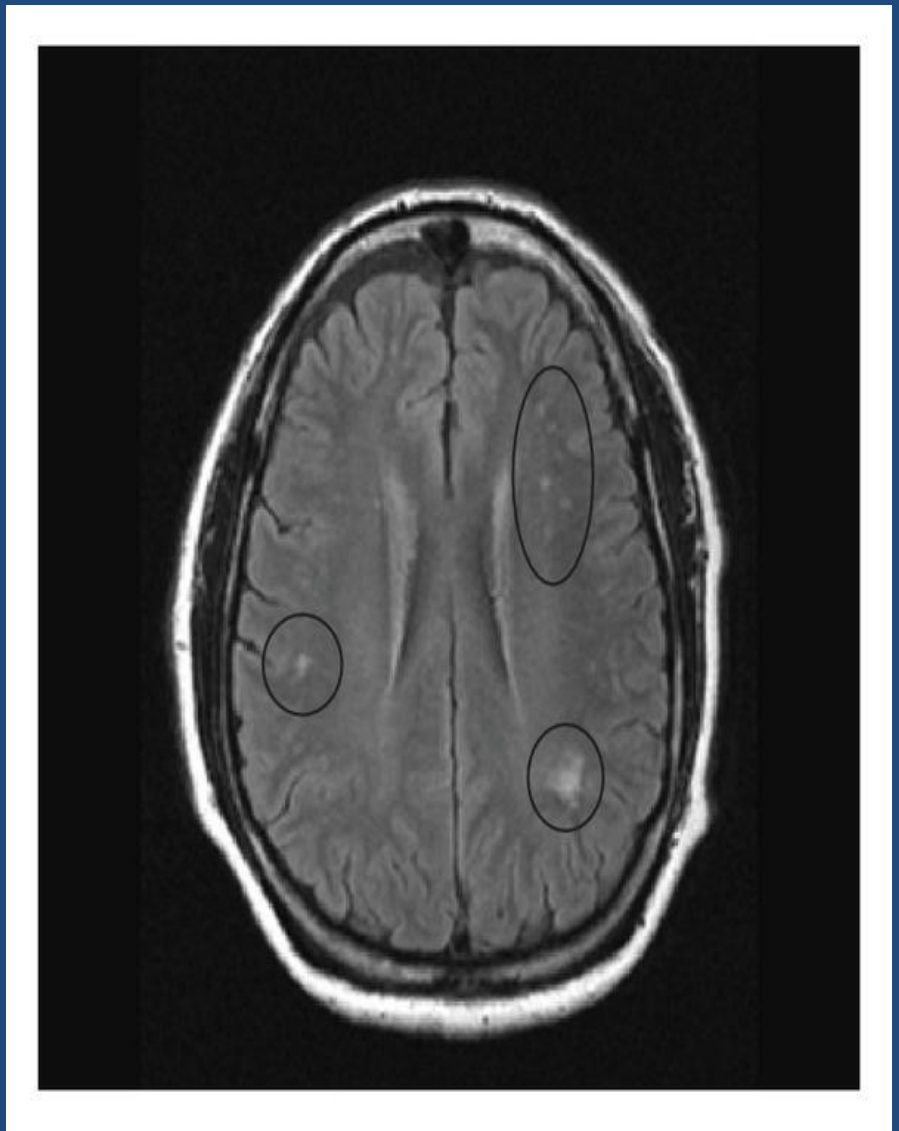
[b]Clinical diagnosis based on objective clinical findings for 2 attacks is most secure. Reasonable historical evidence for 1 past at in the absence of documented objective neurological findings, can include historical events with symptoms and evolution chara istics for a prior inflammatory demyelinating event; at least 1 attack, however, must be supported by objective findings.

[c]No additional tests are required. However, it is desirable that any diagnosis of MS be made with access to imaging based on t Criteria. If imaging or other tests (for instance, CSF) are undertaken and are negative, extreme caution needs to be taken befo making a diagnosis of MS, and alternative diagnoses must be considered. There must be no better explanation for the clinical sentation, and objective evidence must be present to support a diagnosis of MS.

[d]Gadolinium-enhancing lesions are not required; symptomatic lesions are excluded from consideration in subjects with brainste or spinal cord syndromes.

MS = multiple sclerosis; CNS = central nervous system; MRI = magnetic resonance imaging; DIS = dissemination in space; DIT dissemination in time; PPMS = primary progressive multiple sclerosis; CSF = cerebrospinal fluid; IgG = immunoglobulin G.

- Describe the lesion



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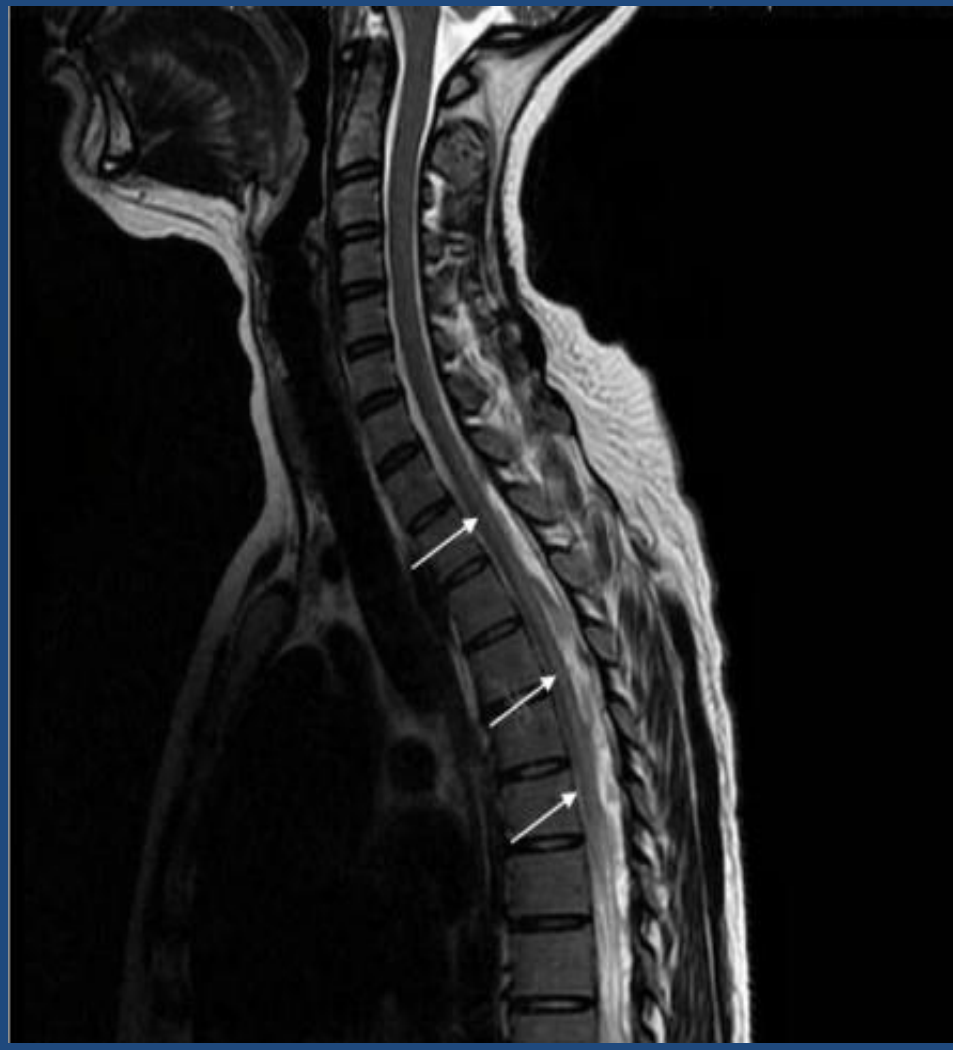
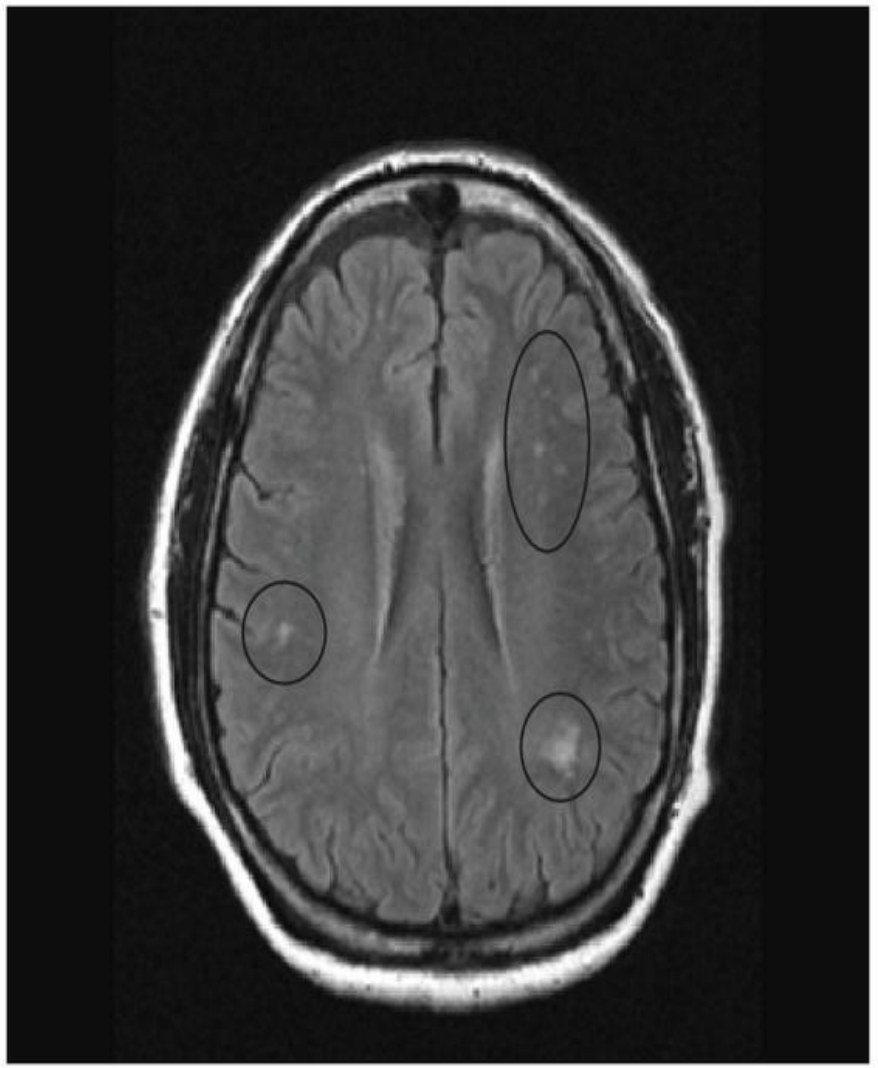


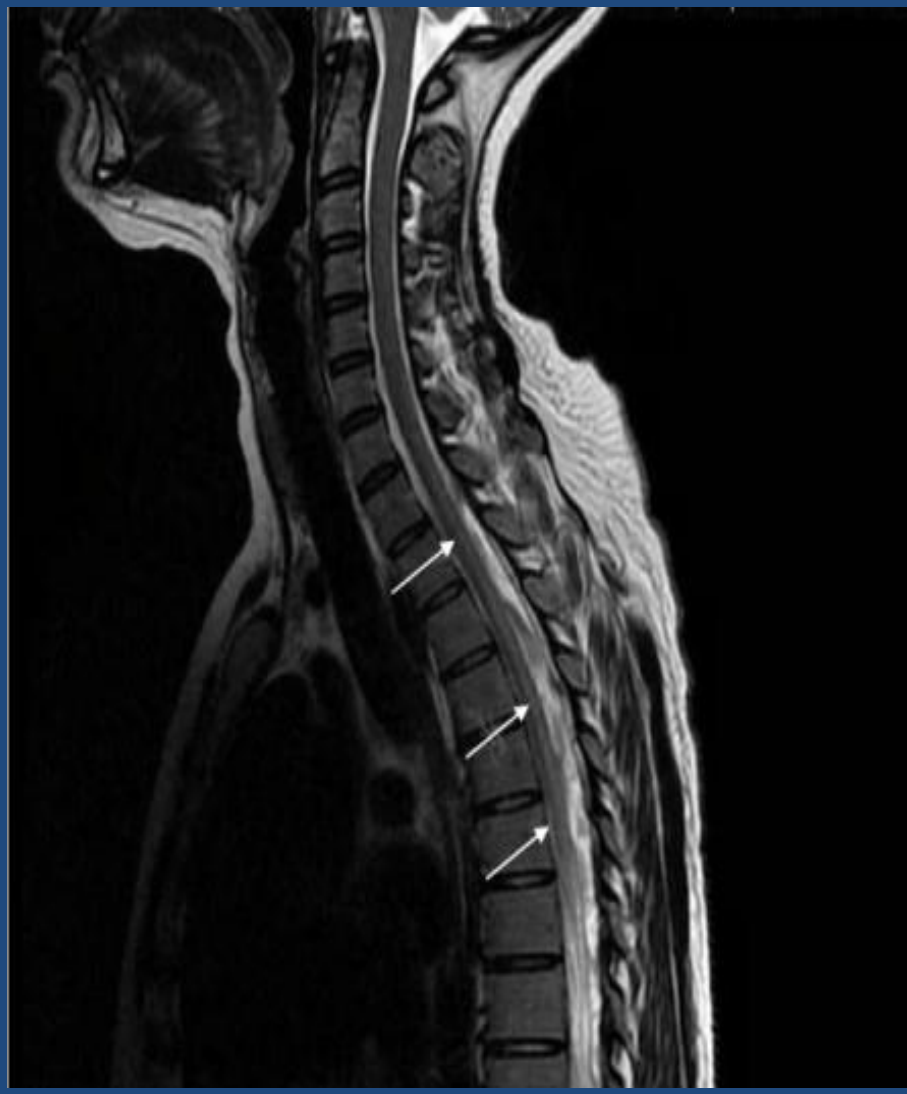
B12 deficiency

Feel weak .red tongue,
bleeding gums,GI symptoms
Numbness,tngling, poor
Sense balance, depression ,
Loss of mental abilities ,
Vibratory loss,psychosis



Cont:

Haematologic abnormality
Increased T2-weighted signal
Decreased T1-weighted
Enhancement of the posterior and lateral columns of the spinal cord (upper thoracic and lower cervical)



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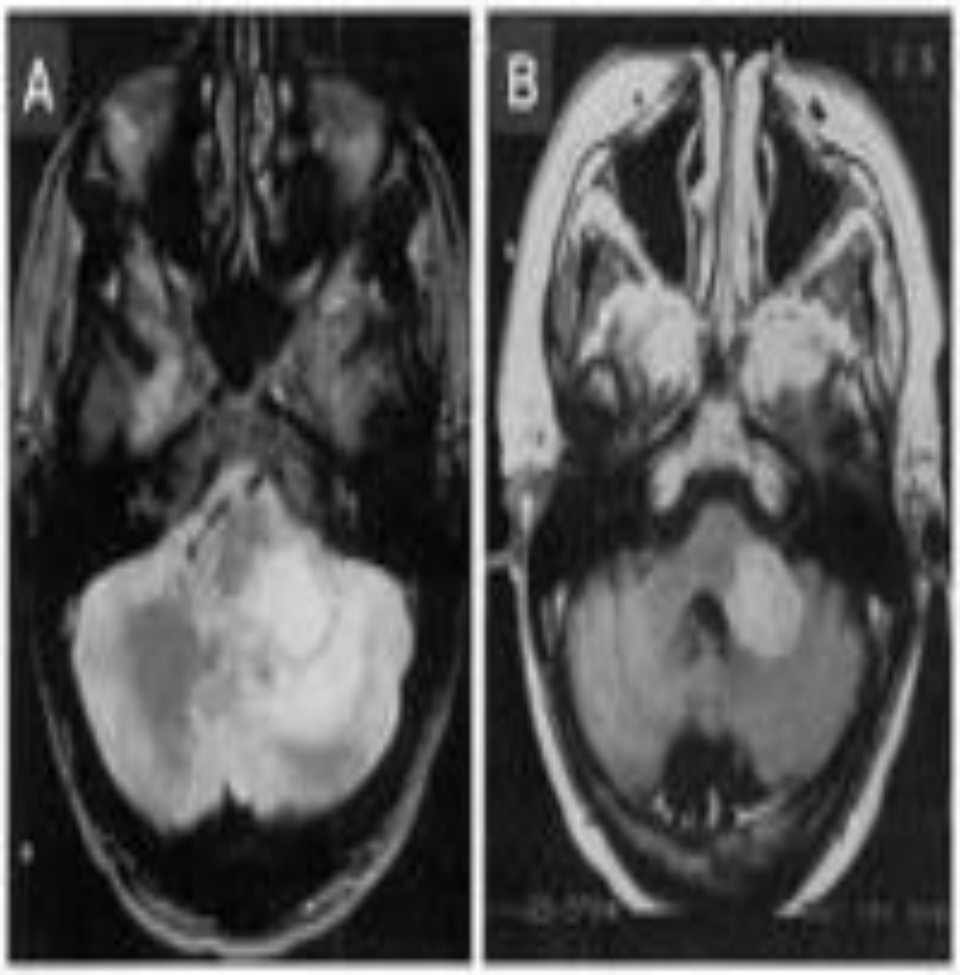
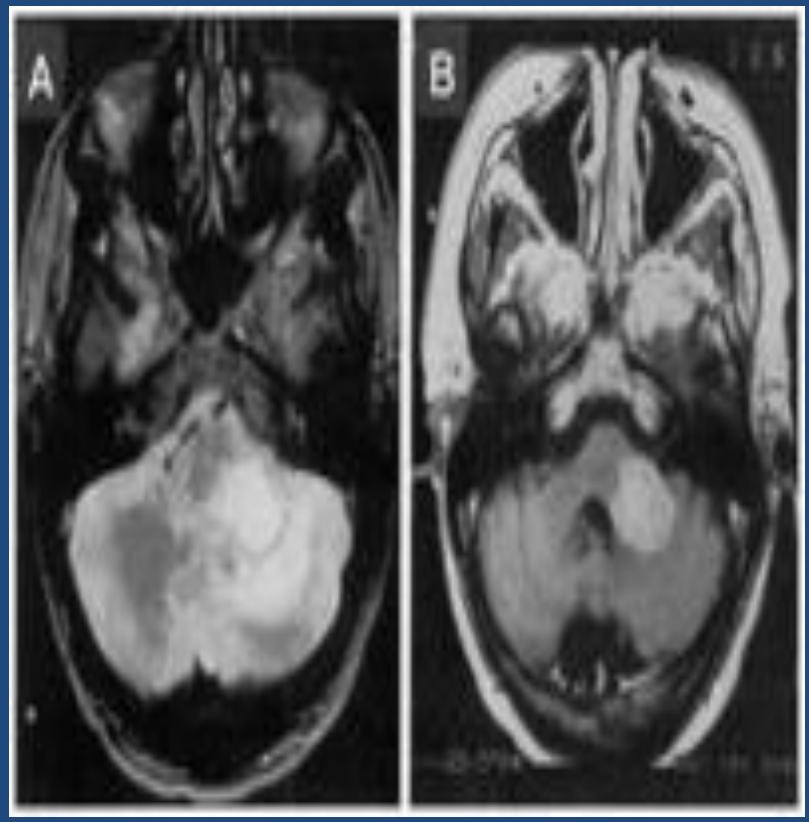
Look at the lesion



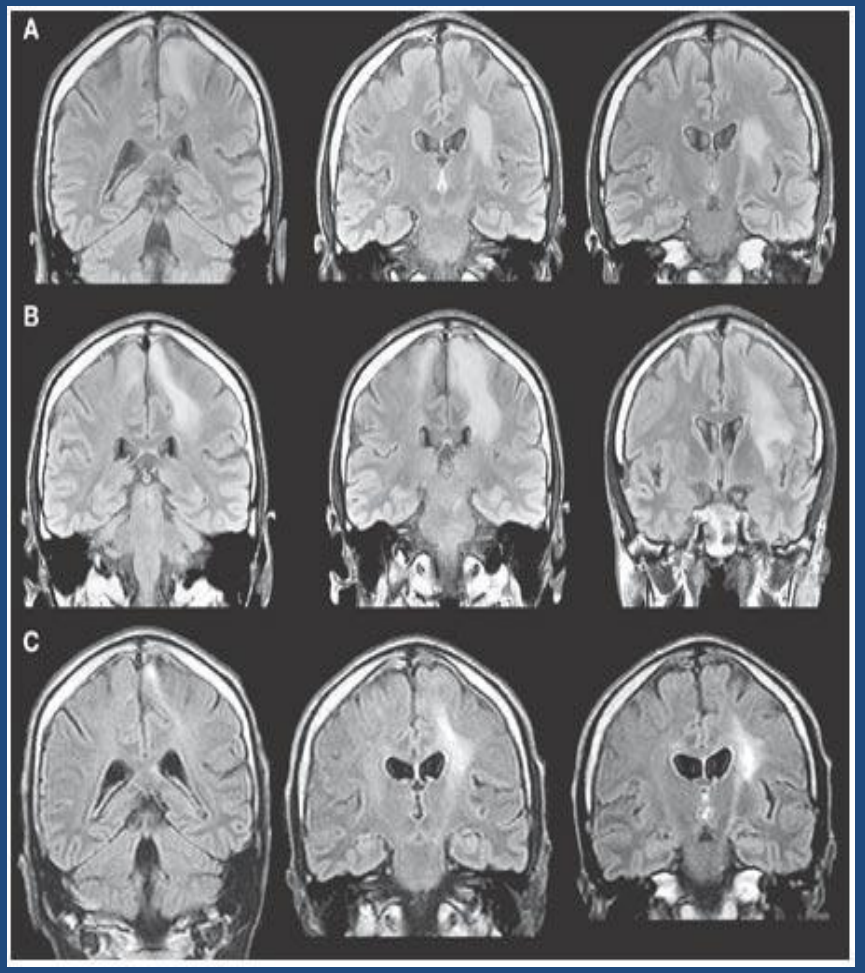
Celiac Disease

- Weight loss
- Abdominal distension
- Steatorrhea,diarrhea

- Toxic effect of gluten or gluten break down products
- Defect of mucosal peptides
- Deodenal biopsy, antigliadin Ab, igA antiendomysial Ab
- IgG antibody against Transglutaminase



- Coronal fluid-attenuated inversion recovery MRI of the patient's brain demonstrating regions of hyperintensity at initial presentation and 2 months later, with partial resolution following 9 months on a gluten-free diet



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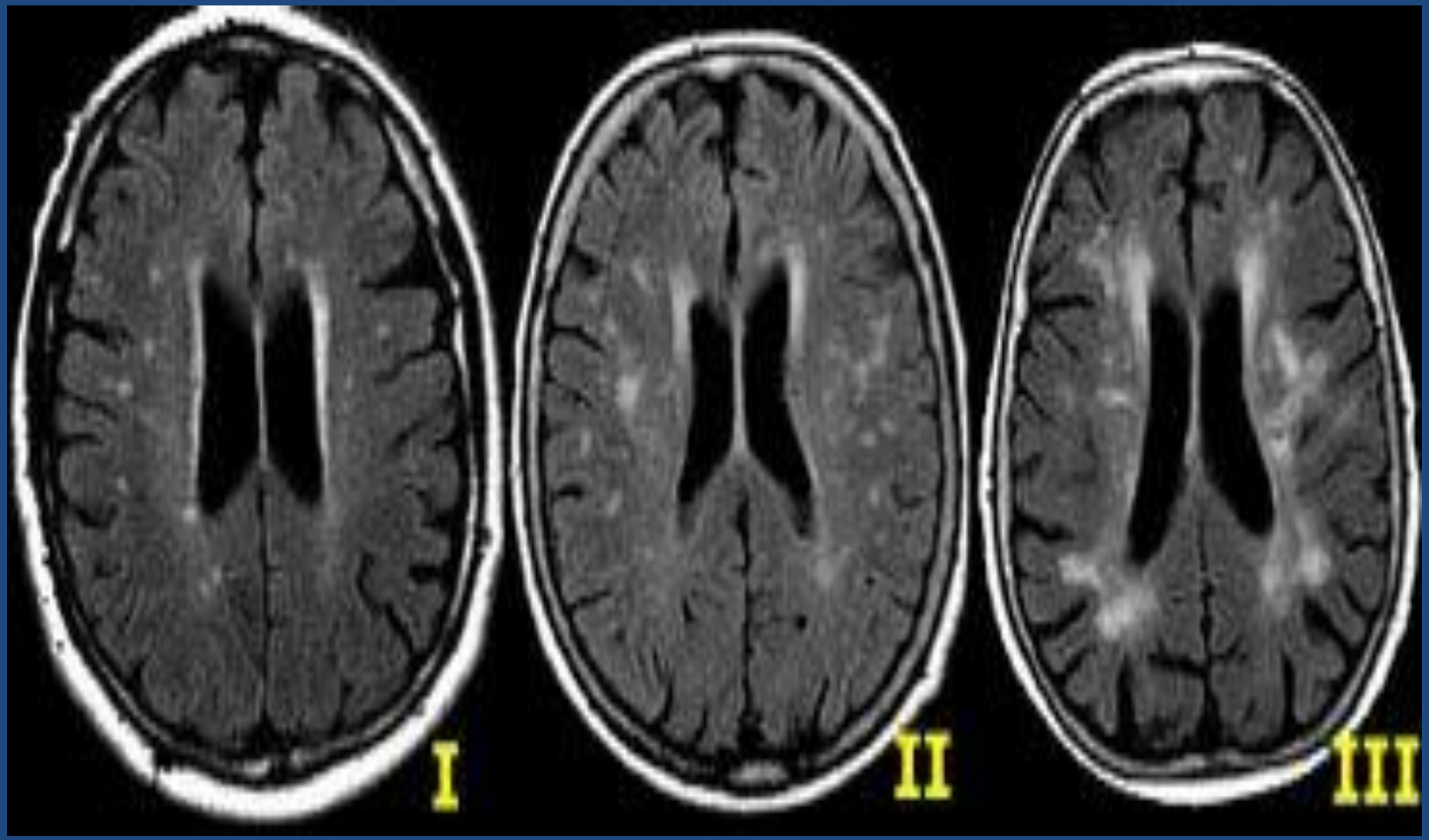
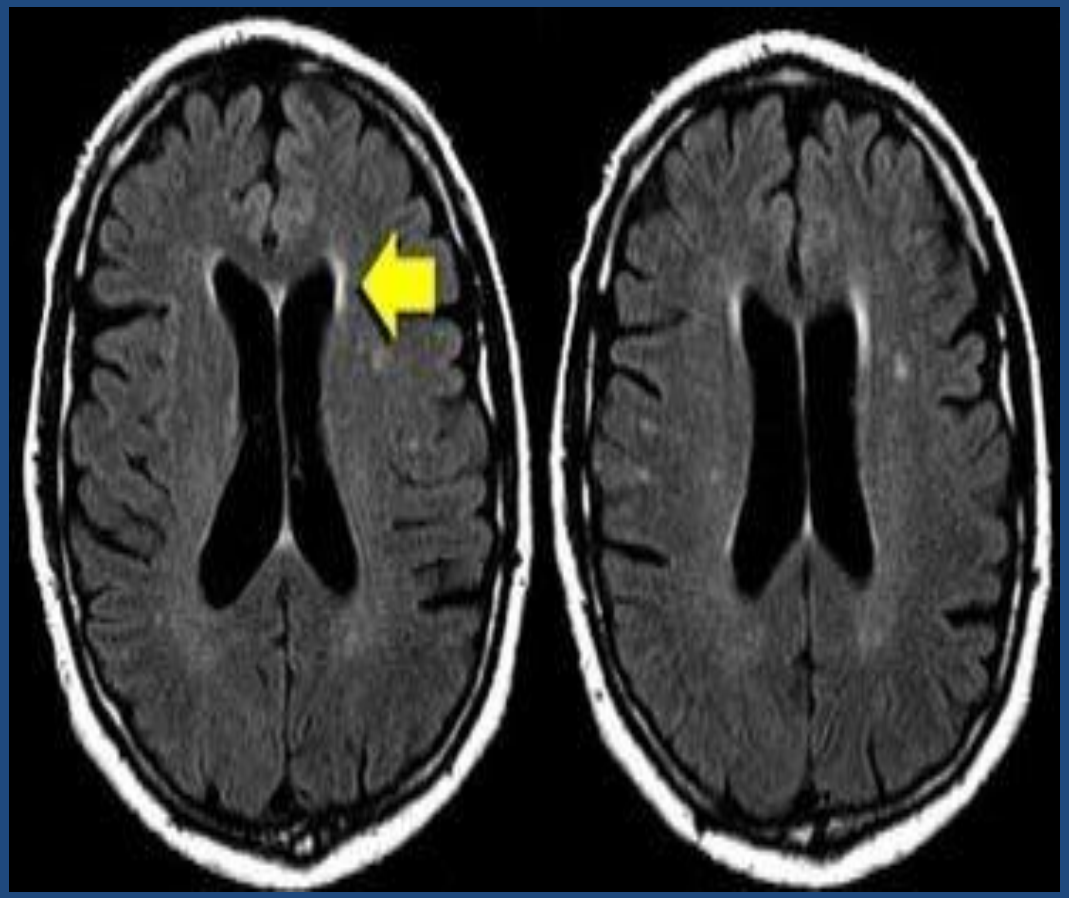
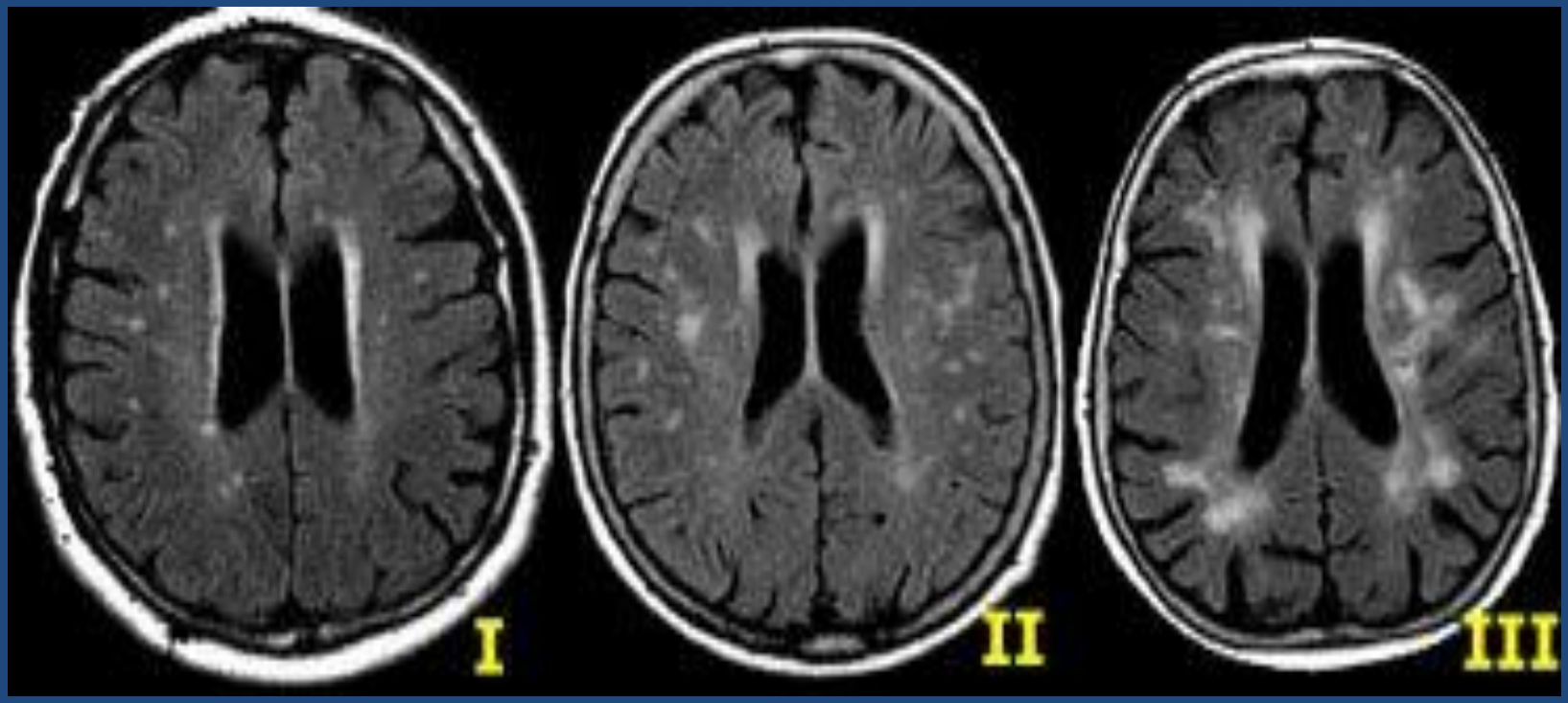

I
II
III

Normal aging

Widening of sulci , periventricular caps (arrow) and bands and some punctate WMLs in the deep white matter





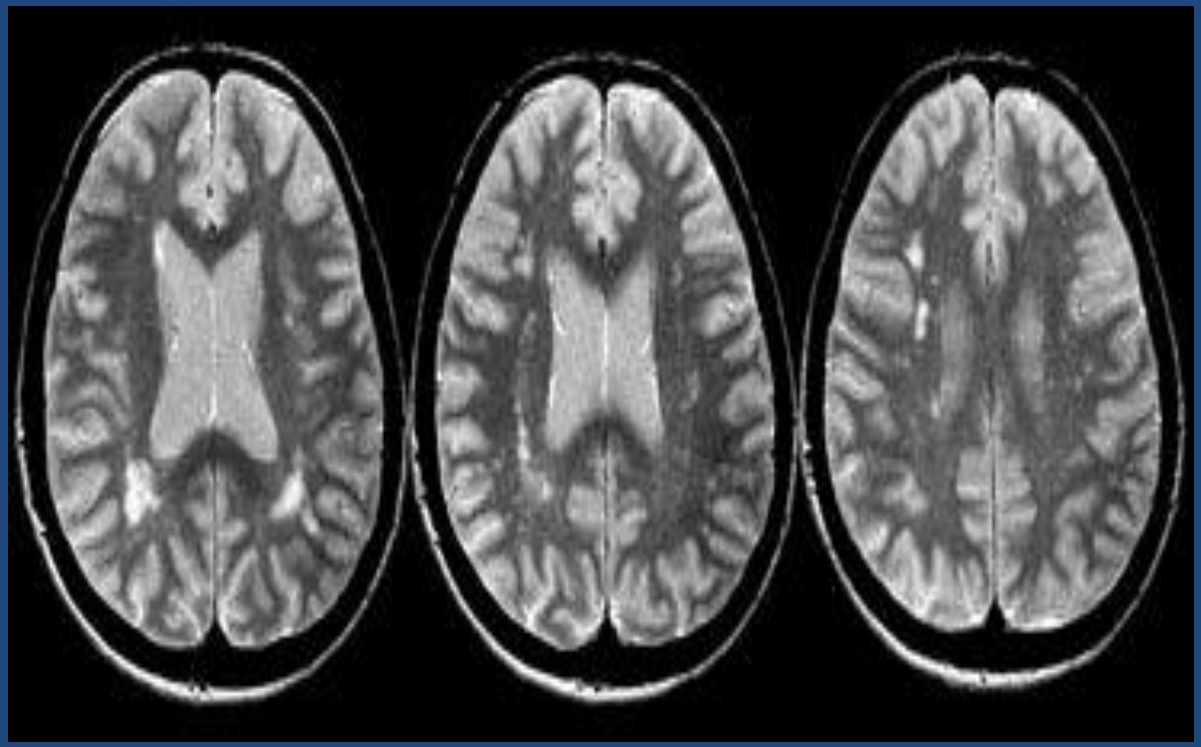
I=FAZEKAS I:PUNCTATE WMLs

II=FAZEKAS II:CONFLUENT WMLs

III=FAZEKAS III:EXTENSIVE CONFLUENT WMLs

?

Look at the picture and describe the lesiones



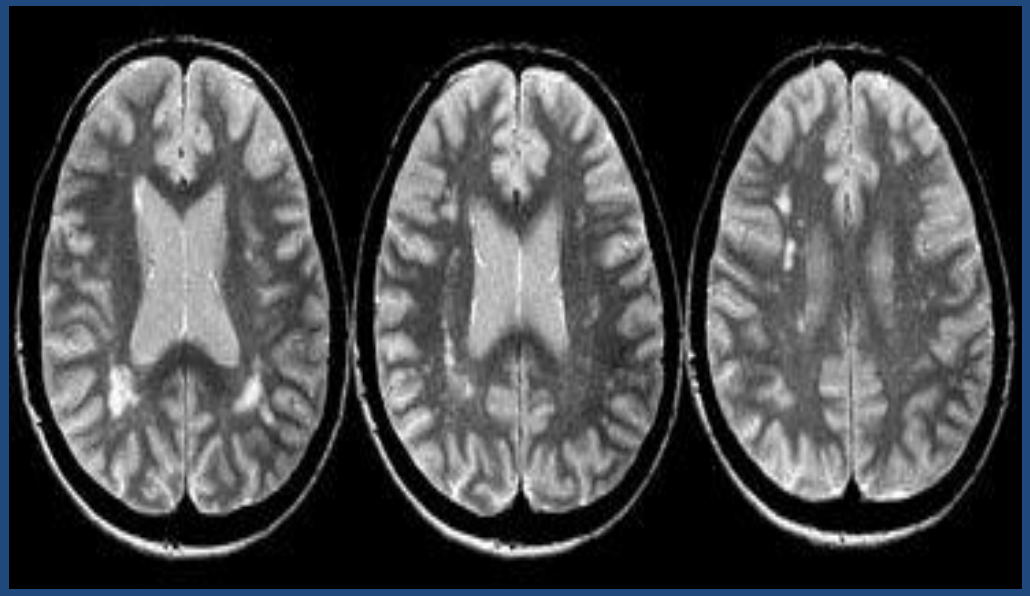
Vascular

The location of these WMLs in the deep white matter

notice:

These lesions are not juxtaventricular , not juxtacortical and not located in the corpus callosum

Unlike MS they do not touch the ventricles or the cortex

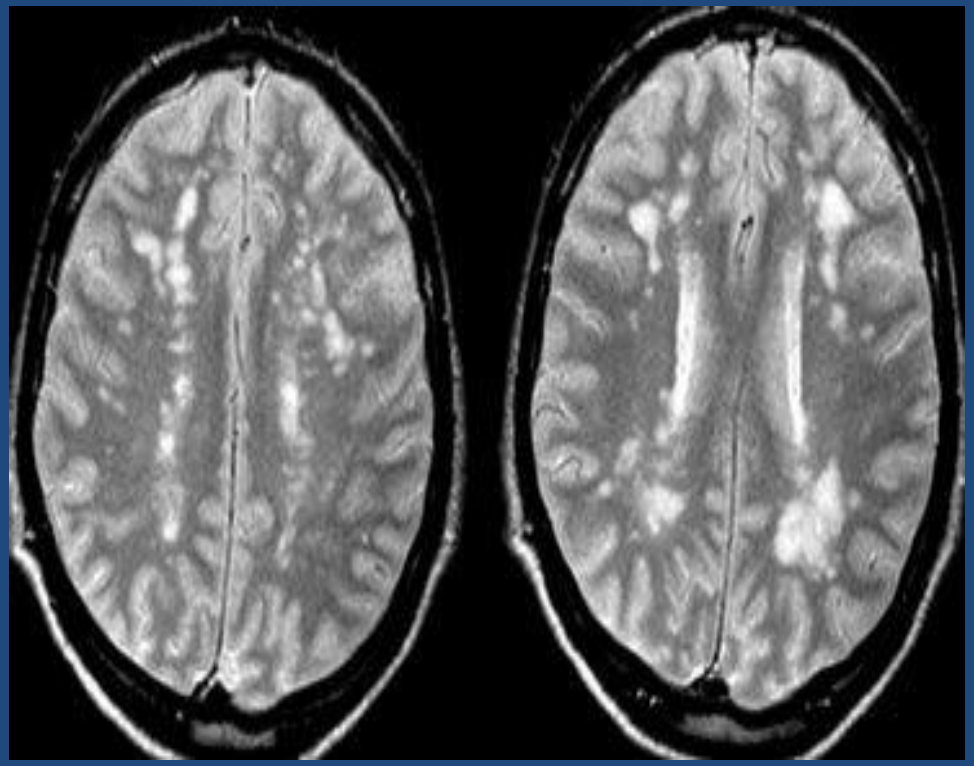


Vascular (cont)

There is widespread disease in the deep white matter but the U fiber and corpus callosum are not involved

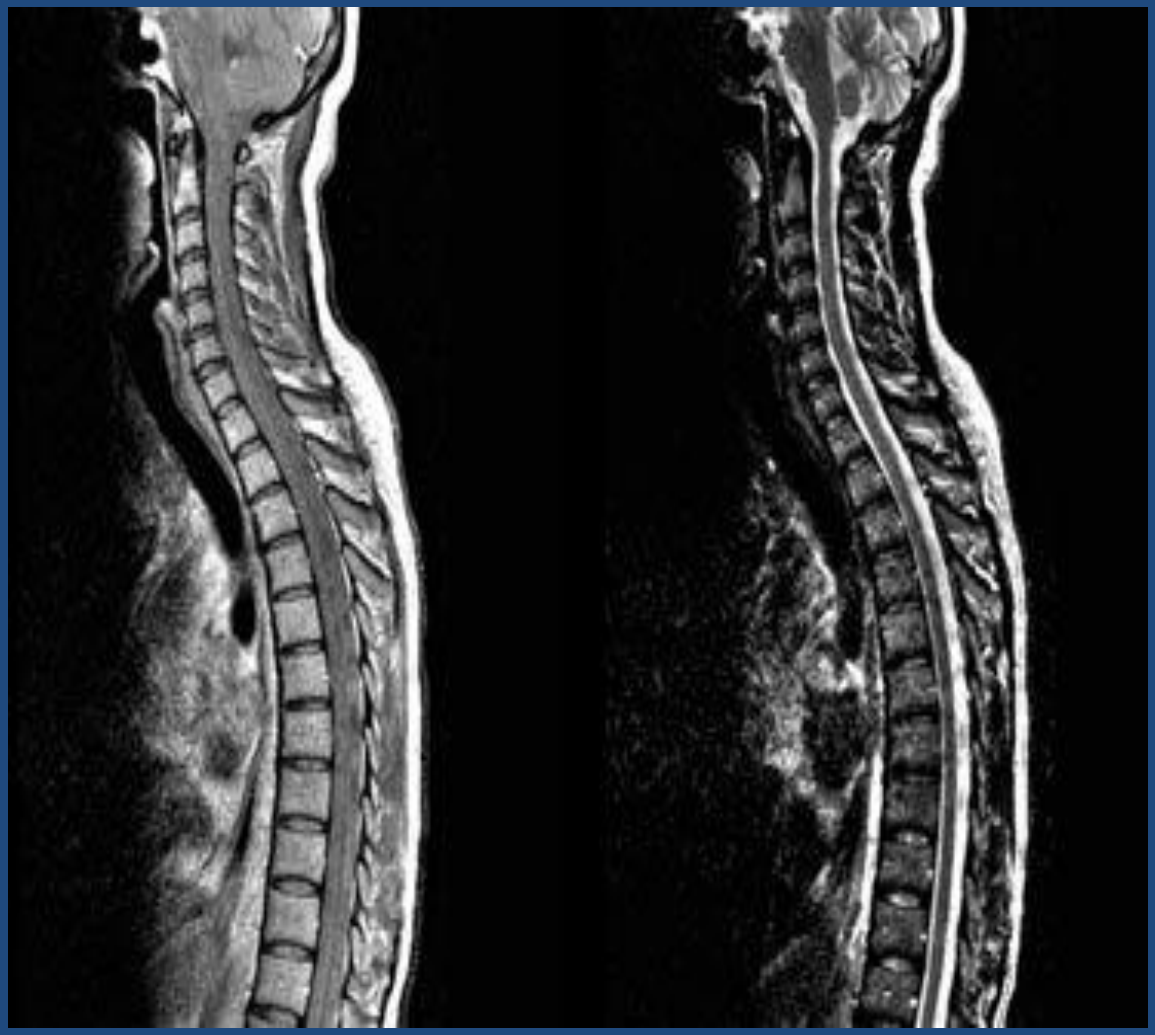
Atherosclerotic brain changes are seen in 50%of patient older than 50 years

They are found in normotensive patient but more common in hypertensives



Vascular Disease

In patient with vascular or ischemia , the spinal cord is usually normal while in a MS patient in more than %90 of the cases it will be abnormal

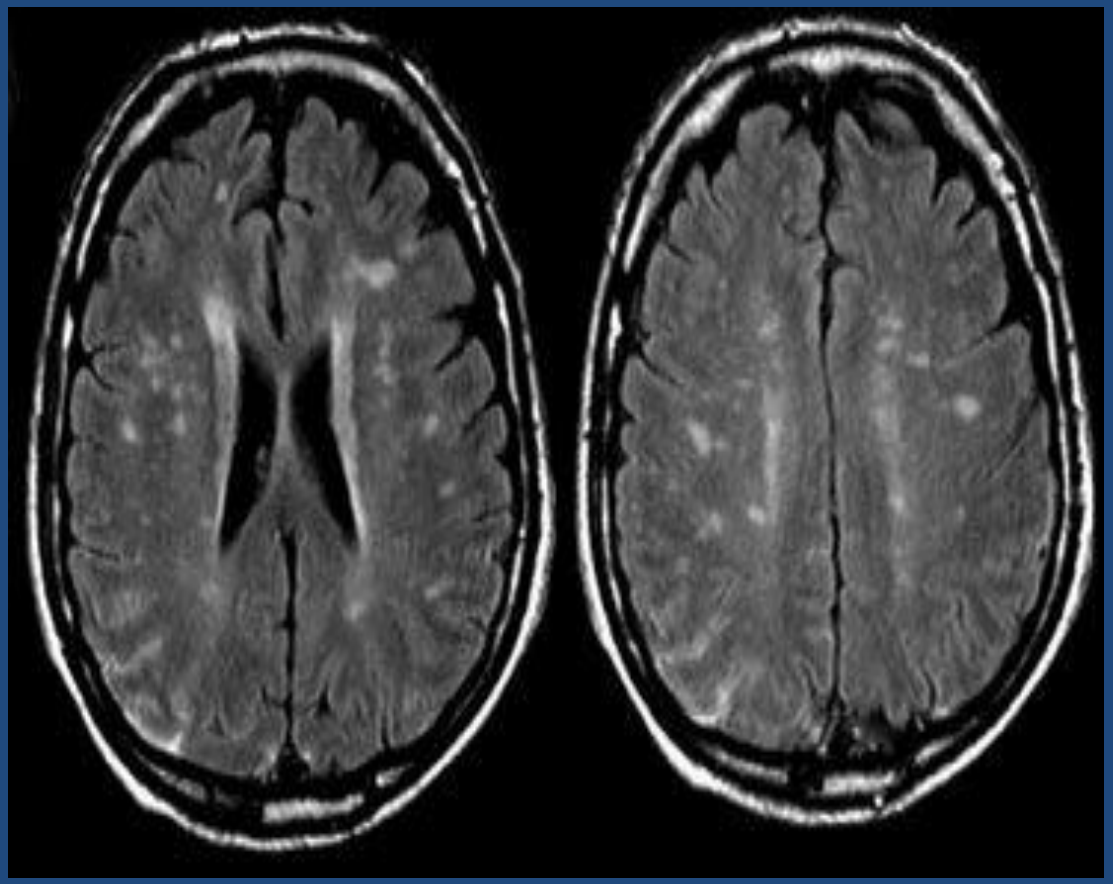


Distribution of WMLs

	MS	Vascular
Corpus callosum	common	uncommon
U-fibers	common	uncommon
Cortical lesions	sometimes	infarction
Basal nuclei	uncommon	typical
Infra tentorial	typical	uncommon
Temporal lobe	early involvement	uncommon
Periventricular	typical	uncommon
Spinal cord	typical	uncommon
Gd-enhancement	yes	no
Dawson fingers	typical	no
Distribution	symmetric/diffuse	asymmetric

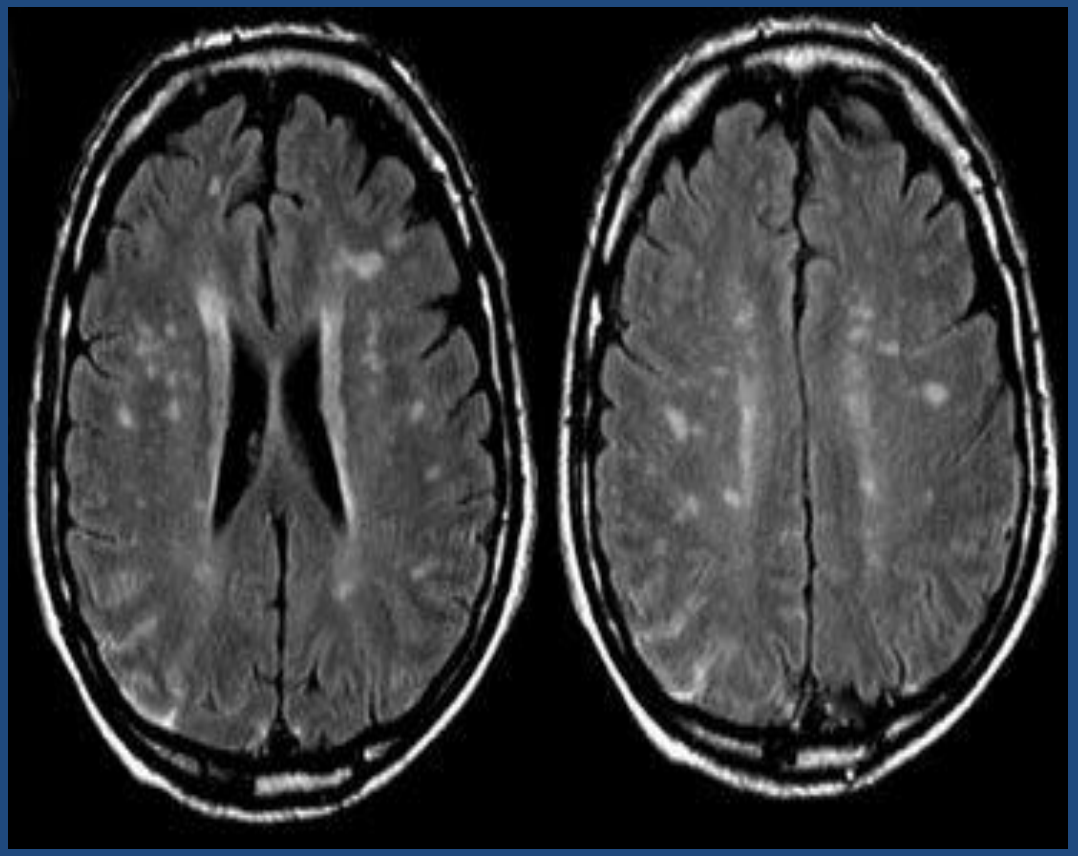
?

Look at the image and describe the lesions



Sarcoidosis

The distribution of lesions is quite similar to MS besides lesions in the deep WM,there are some juxtaiventricular lesions and even Dawson finger –like lesions

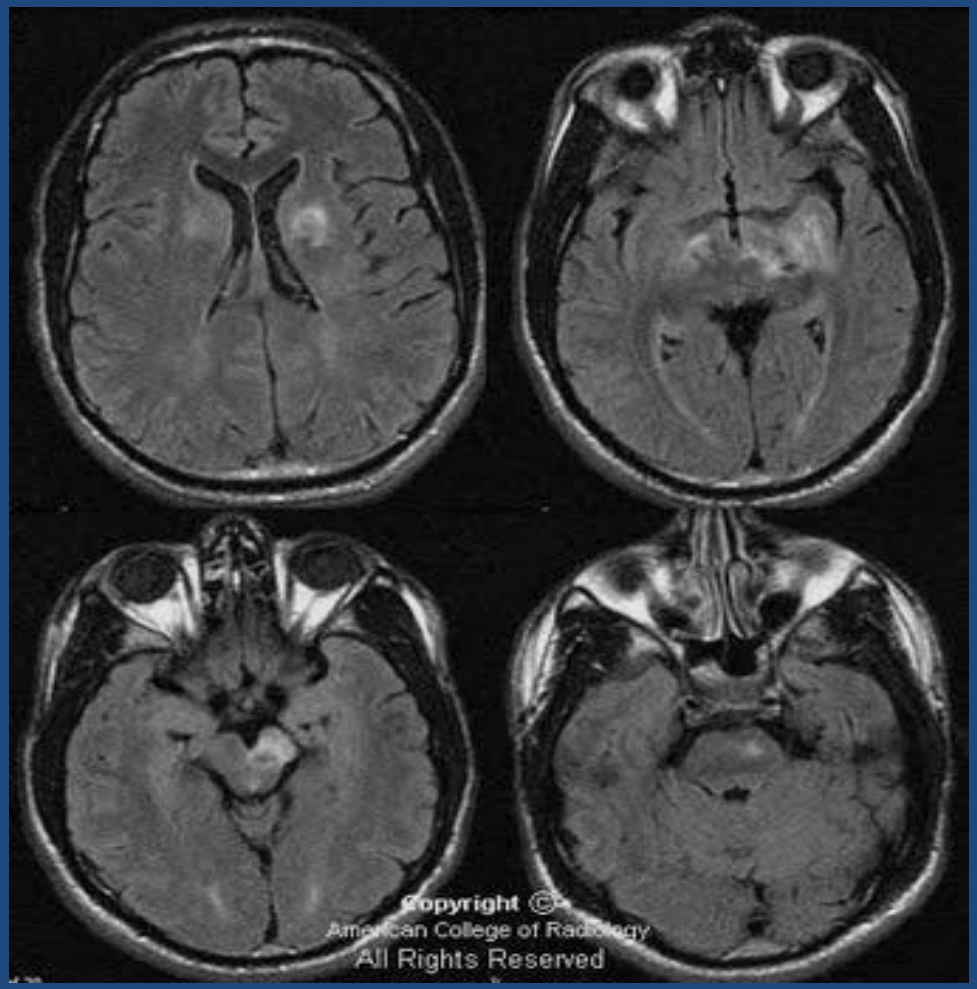


Neurosarcoidosis

- Neurosarcoidosis primarily develops in the leptomeninges.
- Although neurosarcoidosis has a predilection for the base of the brain and basal midline structures , especially the hypothalamus and pituitary gland , any portion of the CNS may be effected, therefore MRI manifestation of neurosarcoidosis are nonspecific.
- MRI may detect subclinical disease ,but a normal MRI does not exclude the presence of neurosarcoidosis, particularly in patients with cranial neuropathies only or undergoing corticosteroid treatment.

Neurosarcoidosis

Peri ventricular white matter lesions

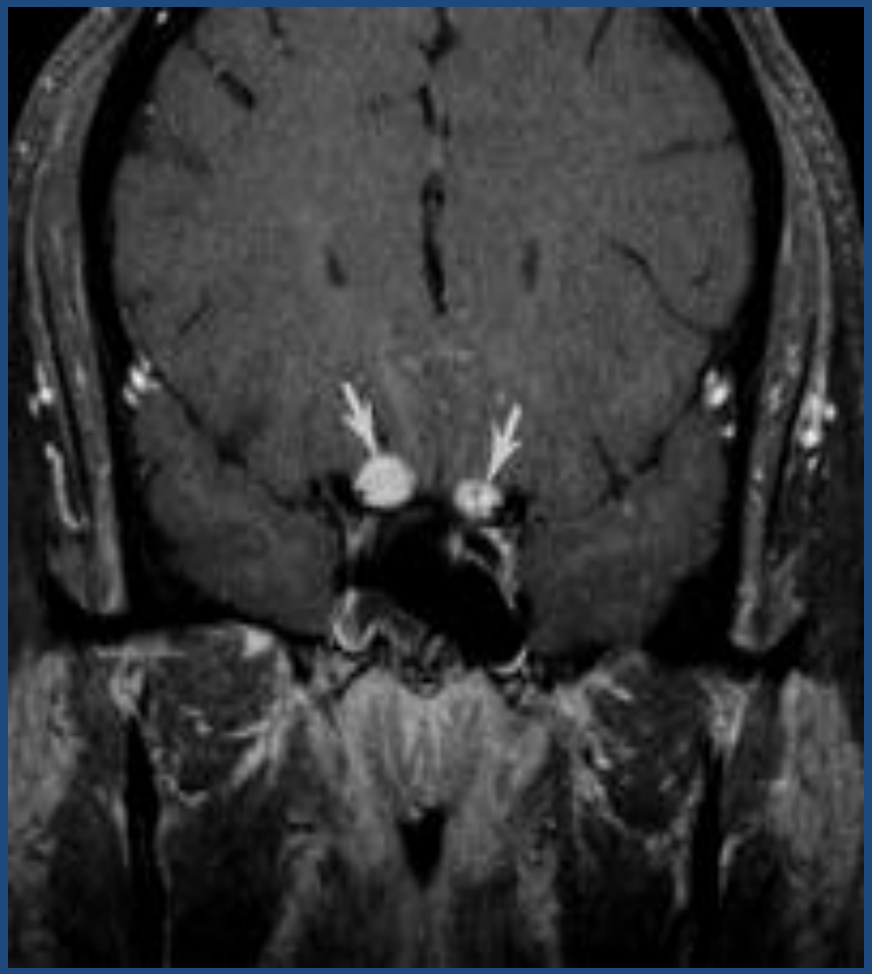


Neurosarcoidosis

The most common abnormalities of neurosarcoidosis on MRI are non enhancing periventricular white matter lesions and meningeal enhancement

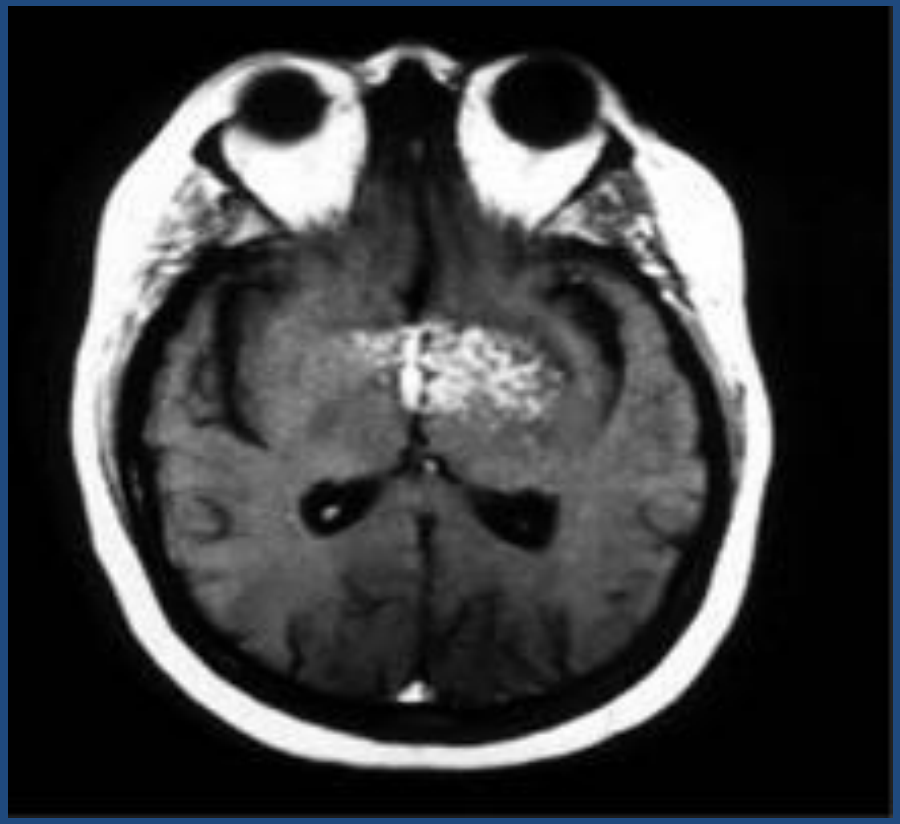
Neurosarcoidosis

Optic nerve involvement



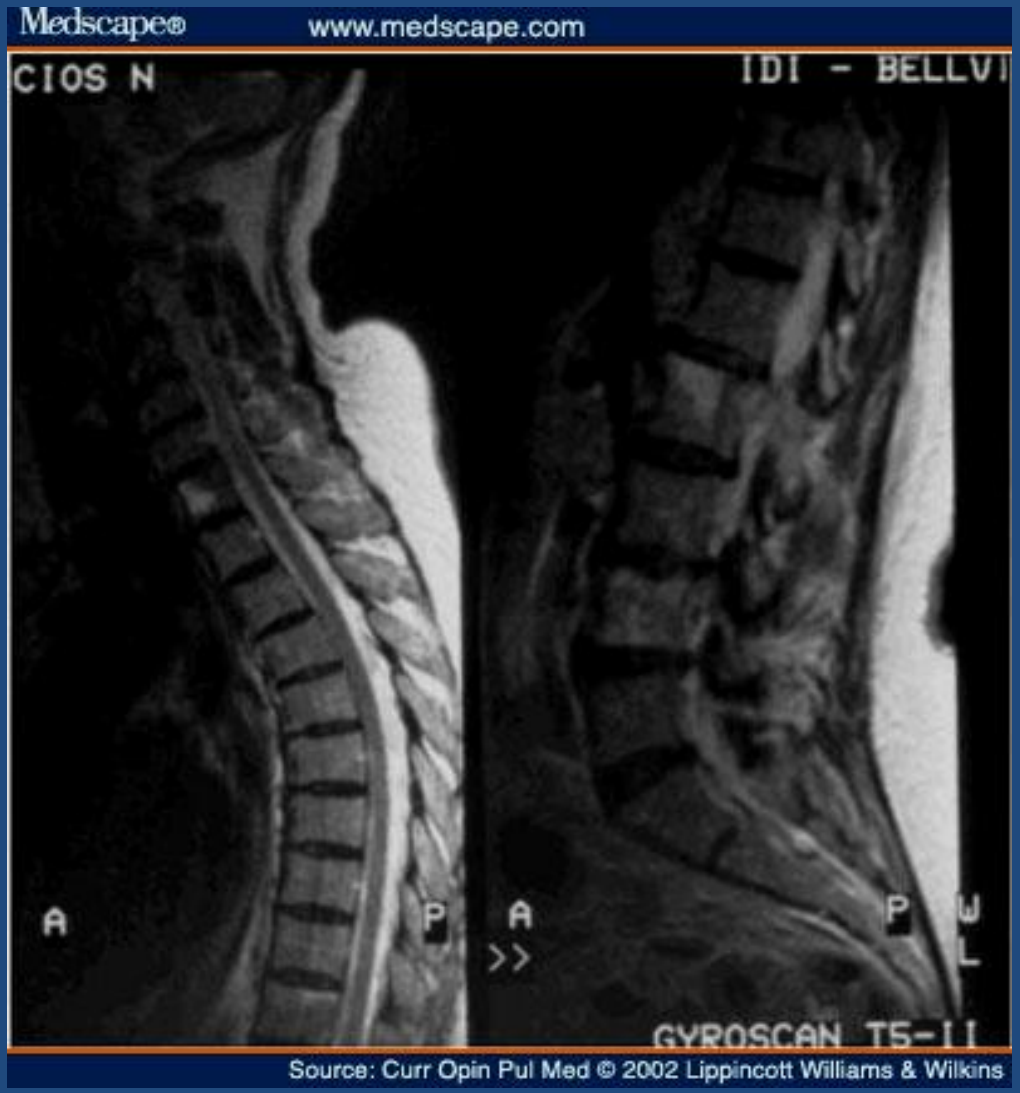
Neurosarcoidosis

Enhancing brain parenchymal lesions



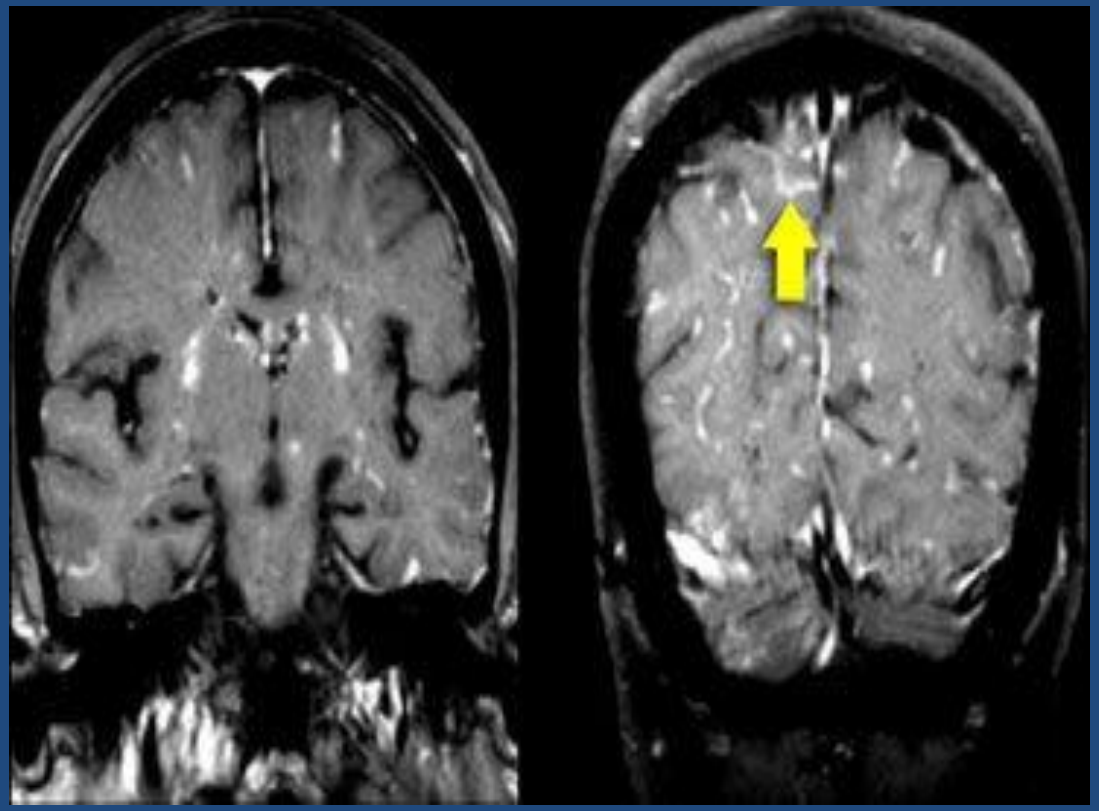
Nurosarcoidosis

Cervical and lumbar vertebral involvement



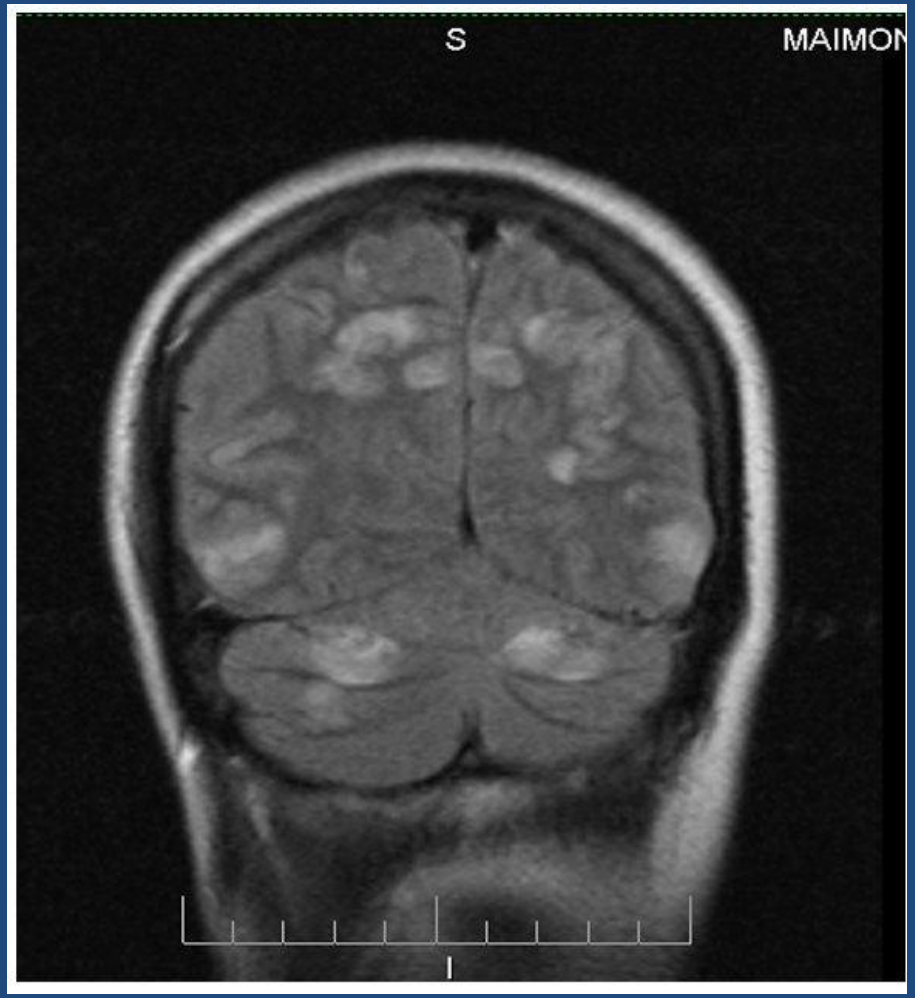
Neurosicoidosis

Leptomeningeal enhancement and punctate enhancement in BG



?

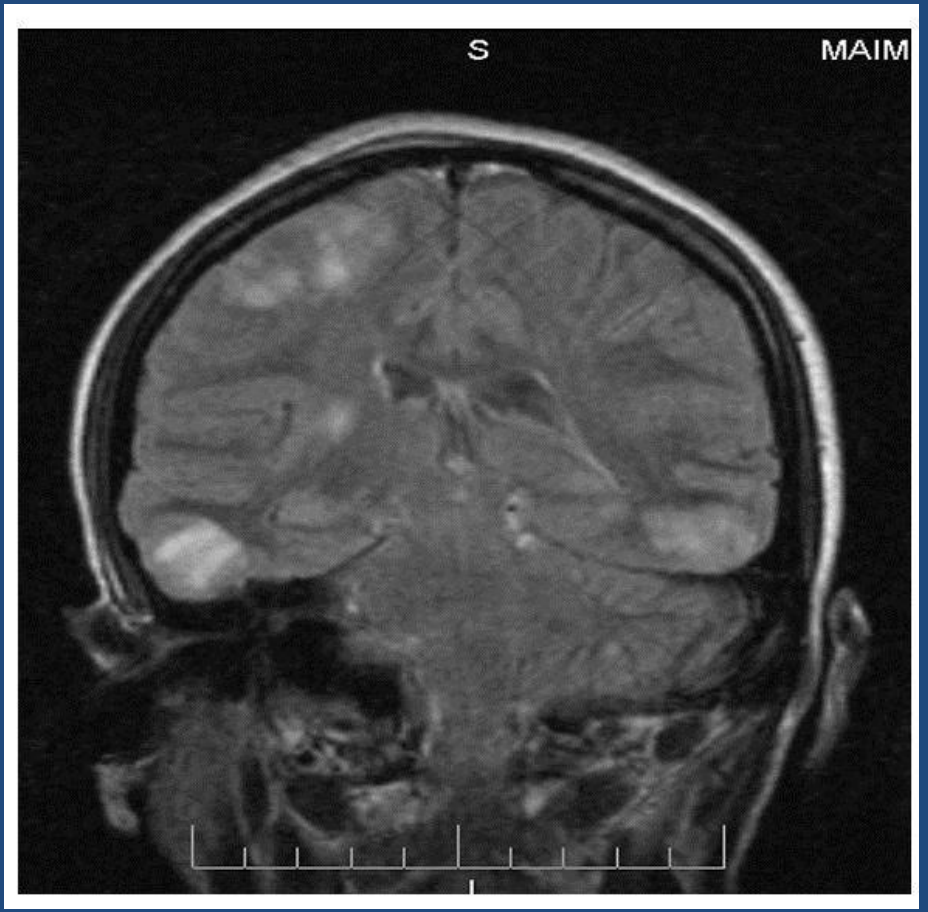
Describe the lesion



SLE

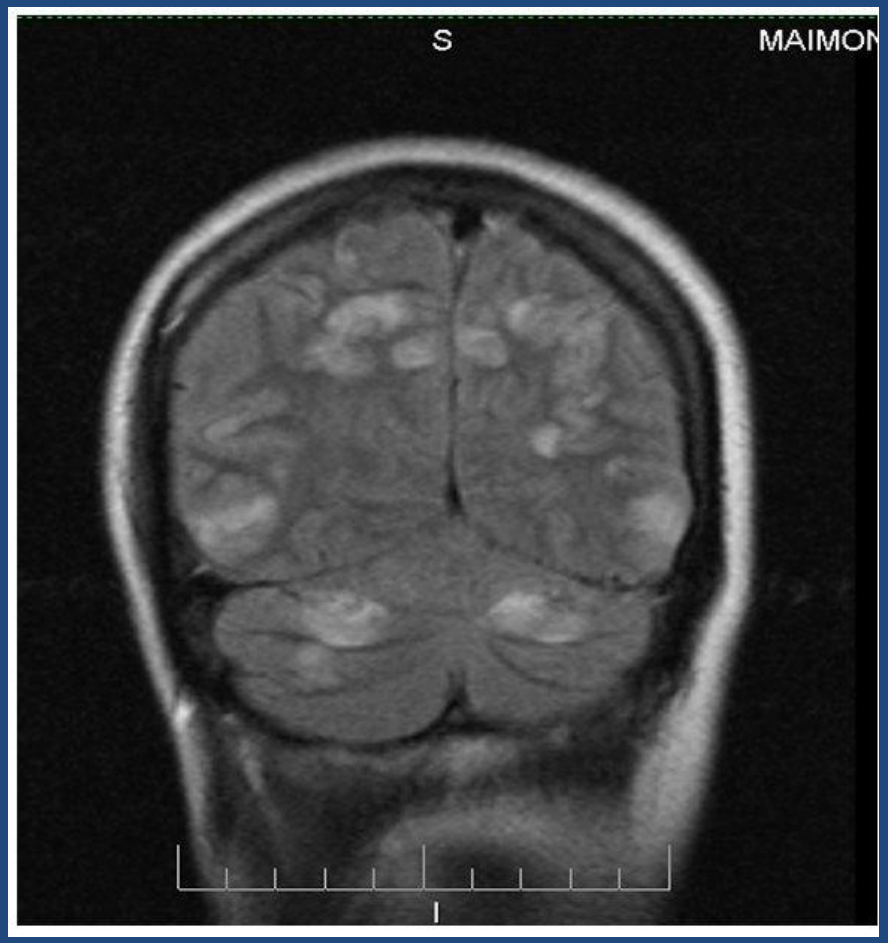
MRI changes are nonspecific and may reveal small or large cerebral infarcts

Gad enhancement is less common than in MS and T1 black holes are rarely seen



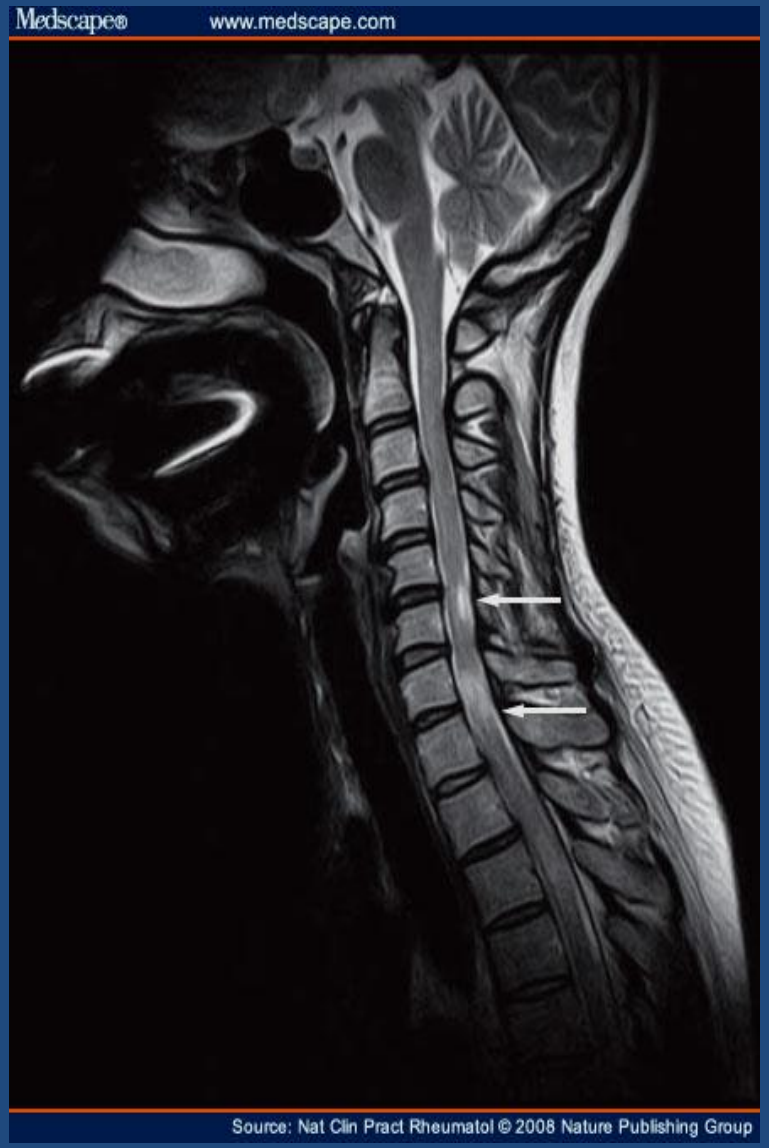
SLE

Small punctual lesions of increased signal intensity , located mainly in the periventricular and subcortical white and gray matter .this lesions may mimic MS classic appearence



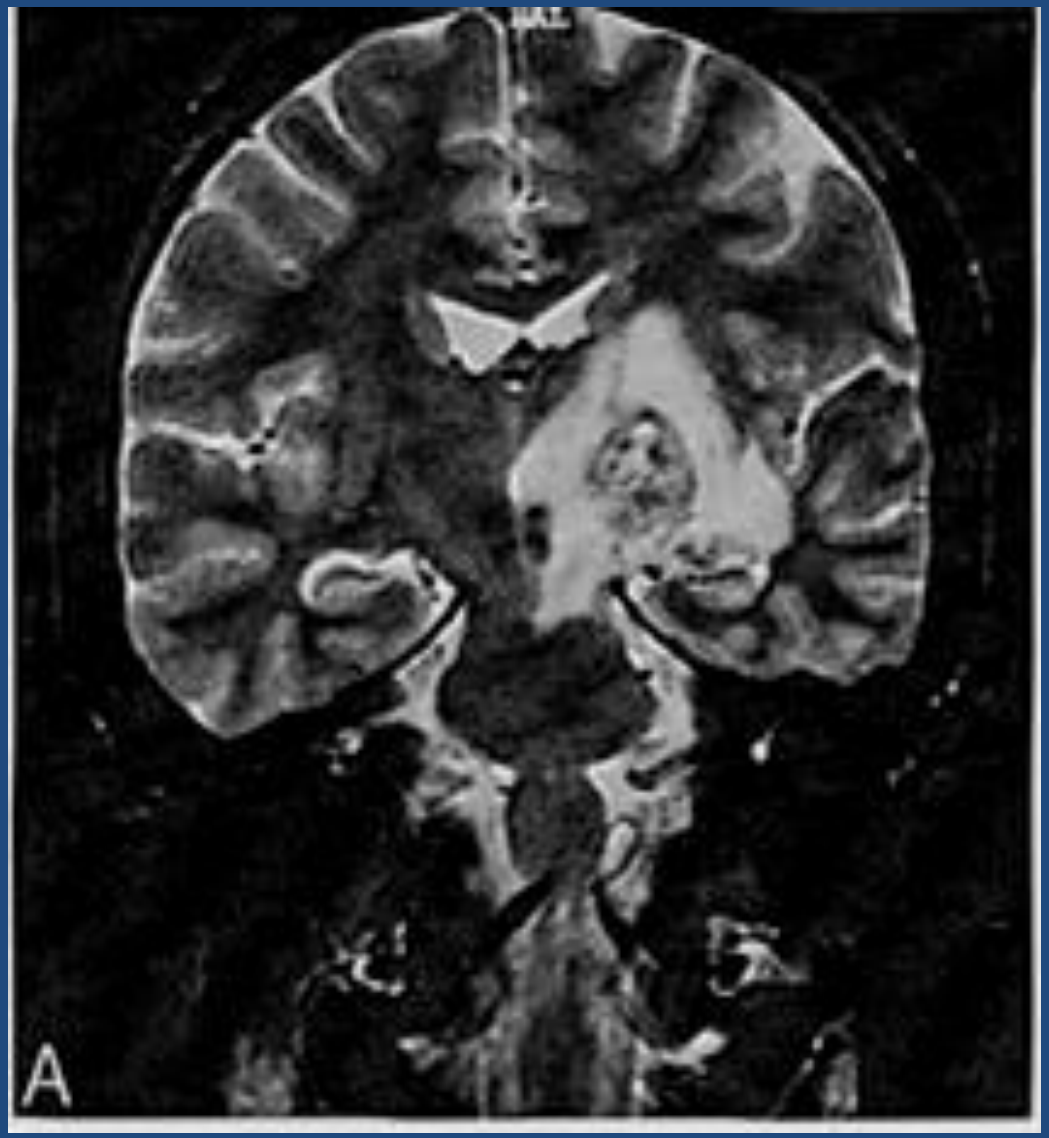
SLE(cont)

Spinal cord lesion is less common than in MS



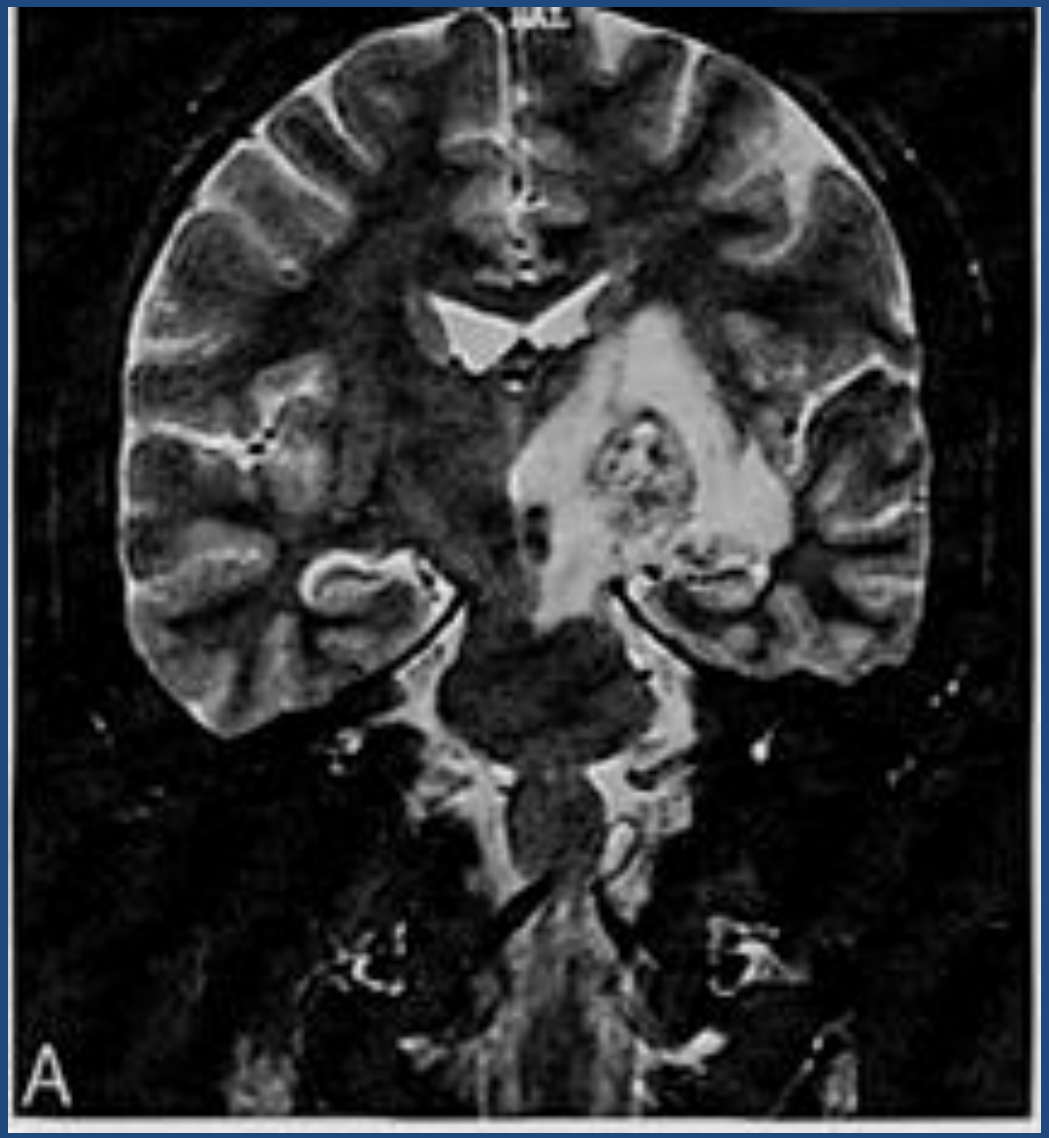
?

Look at the lesion and describe the lesion



Neuro-Behcet-Syndrome

Coronal T_2 shows heterogenous left MDJ lesion with extensive edema, sparing the red nucleus

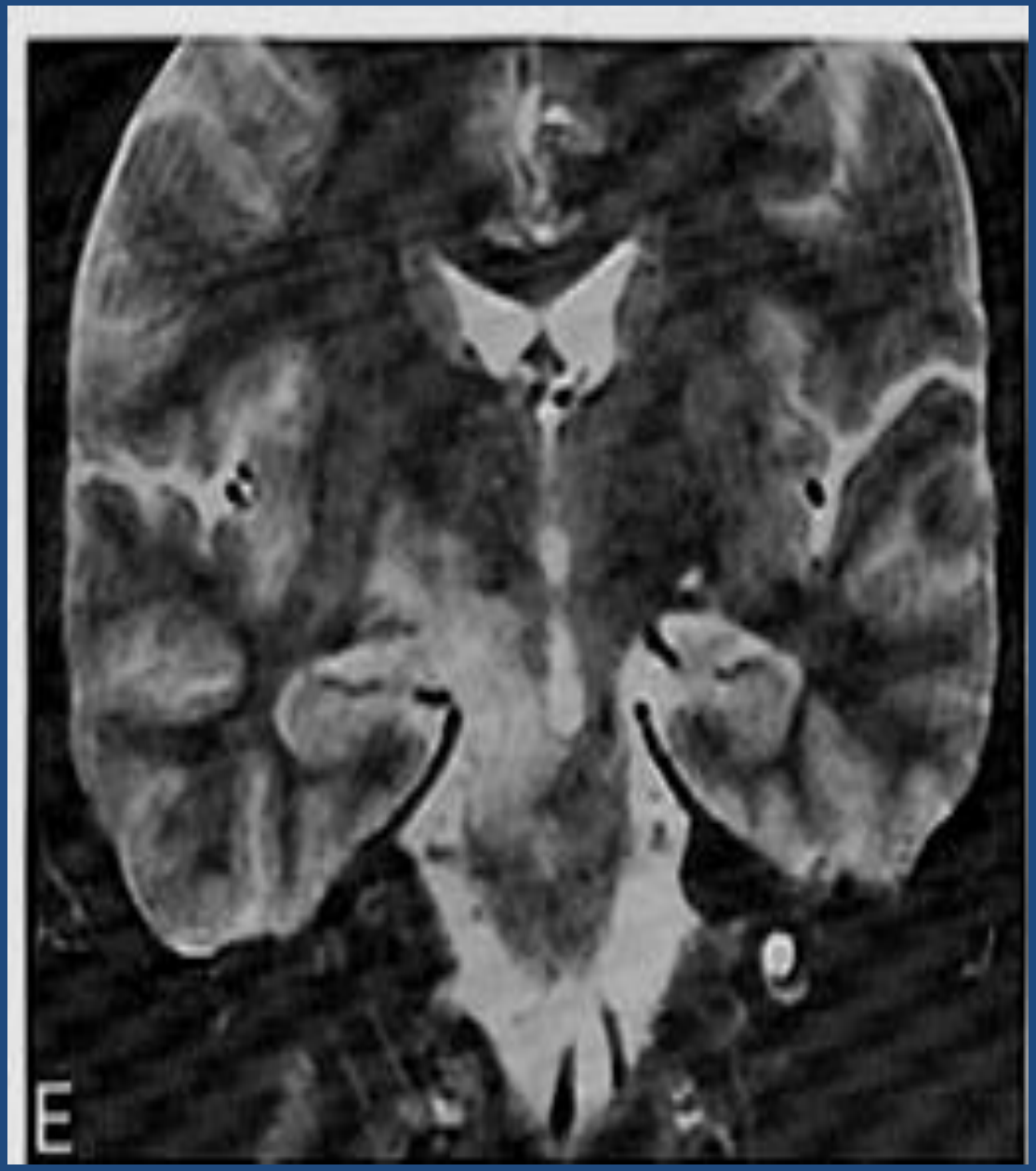


Neuro- Behcet- Syndrome

- The most common imaging finding in NBS patients who had neural parenchymal involvement is mesodiencephalic junction and edema extending along certain long tracts in the brain stem . diencephalon,pontobulbar region,cervical spinal cord, optic nerve, BG,hypothalamic – thalamic region,cerebellum involvements are next common locations.

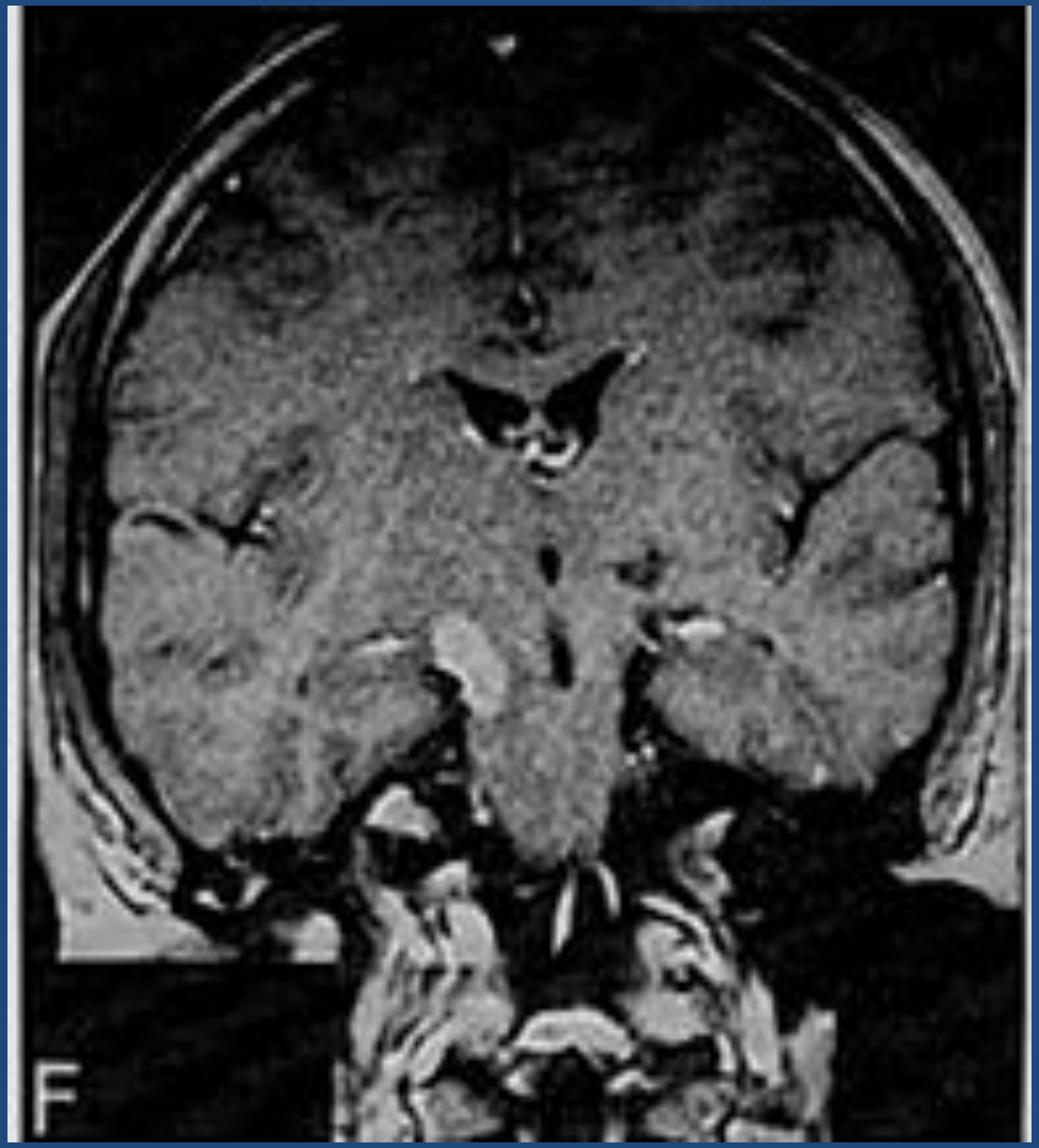
NBS(cont)

Two years later,after another relapse of the disease,reveal a controlateral MDJ lesion(T_2)



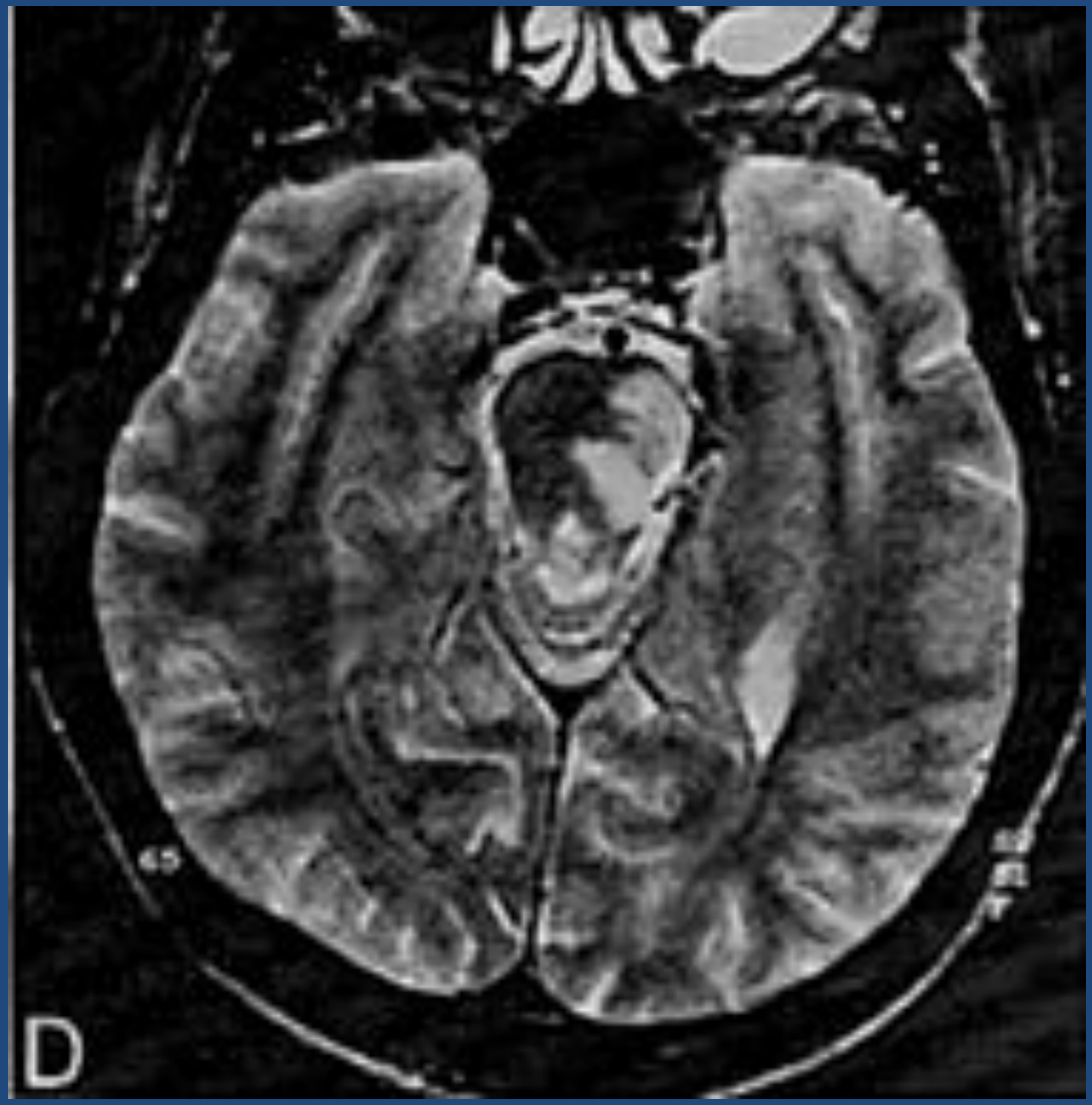
NBS(cont)

Contrast-enhanced (T_1 w) shows enhancement of the new right MDJ lesion



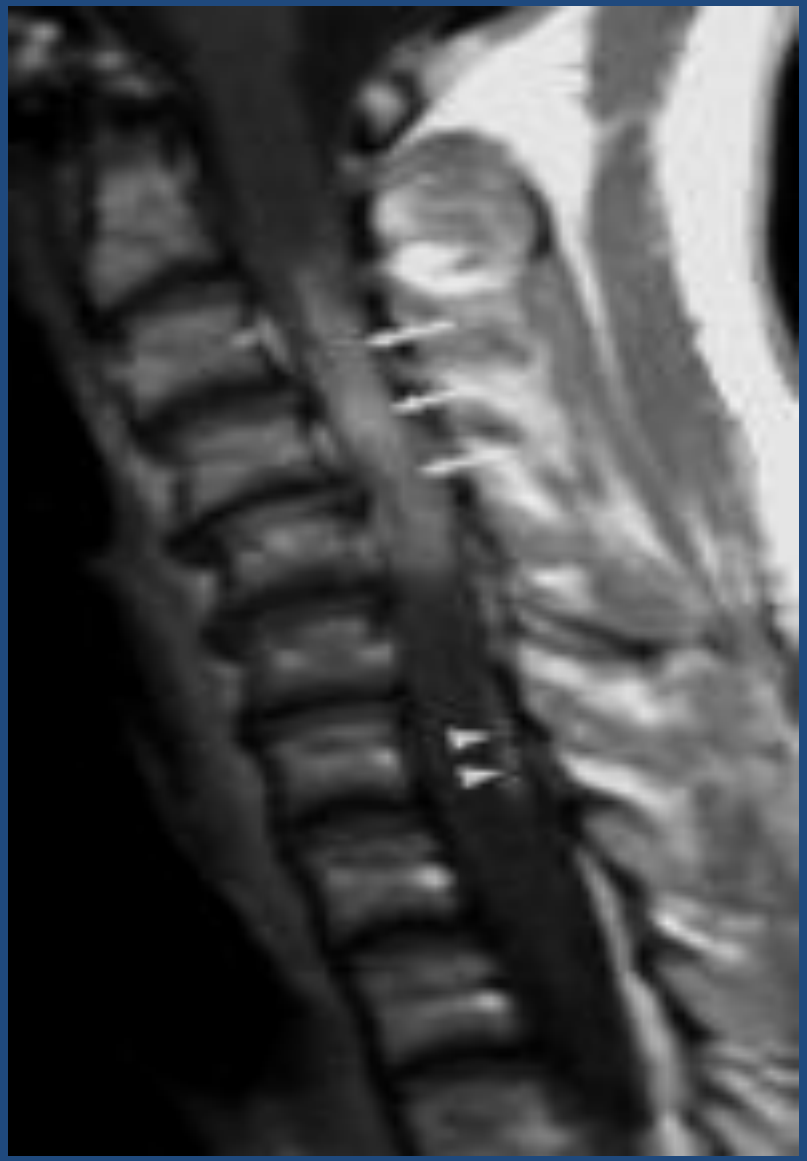
NBS(cont)

Involvement of pontin tegmentum



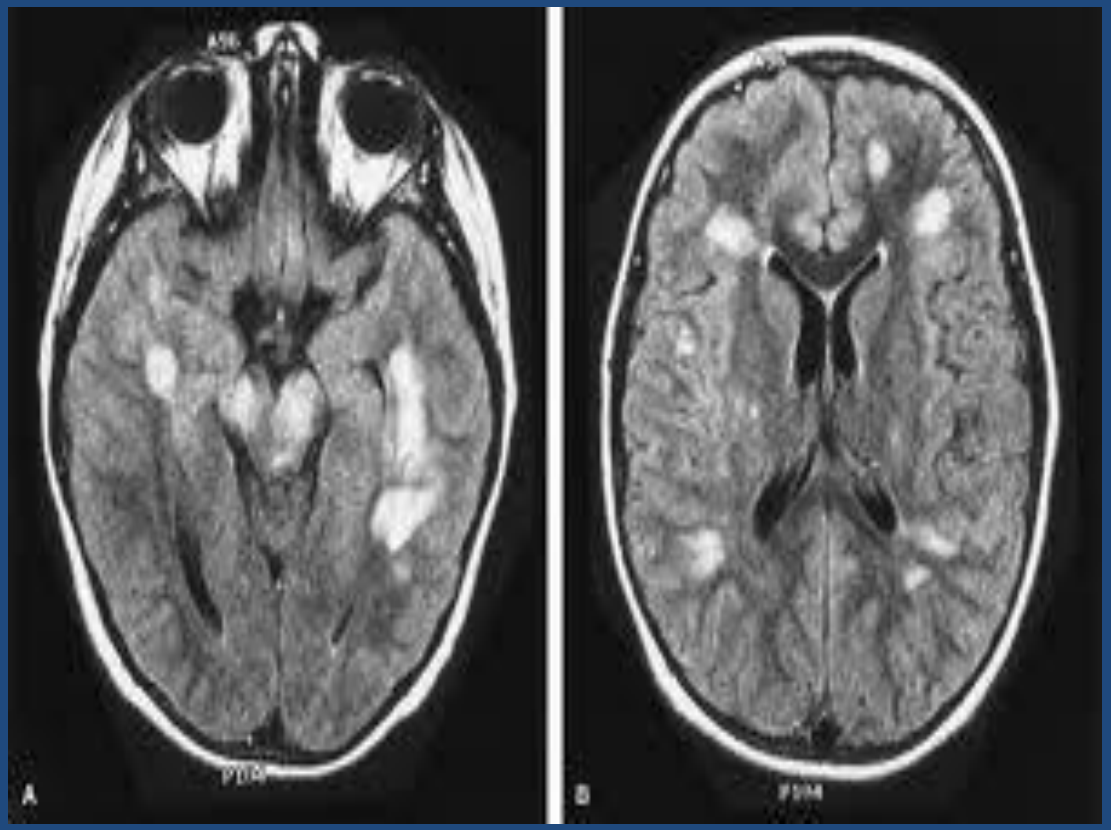
Neuro Behcet (cont)

Spinal cord involvement



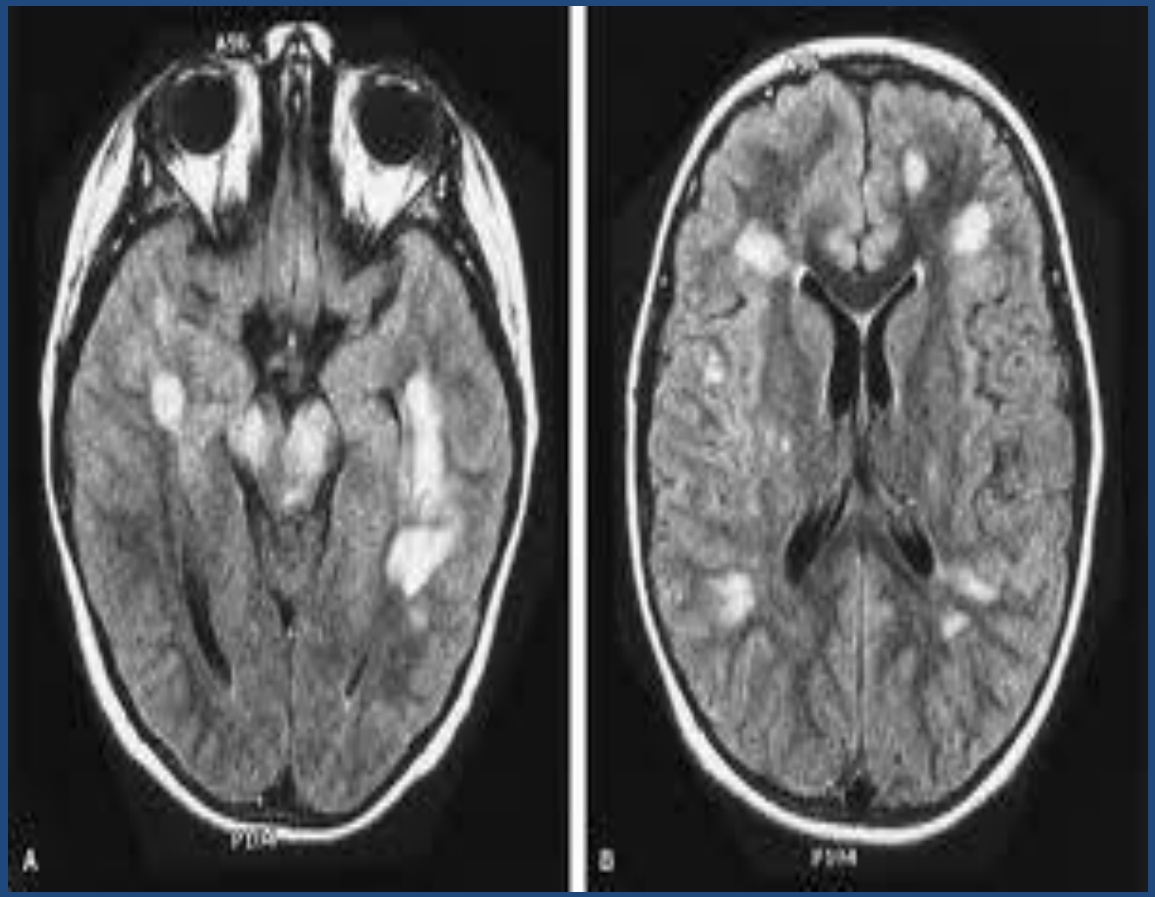
?

Look at the images and describe the lesions



ADEM

Multifocal lesions in WM and B G,10-14 days following infection or vaccination



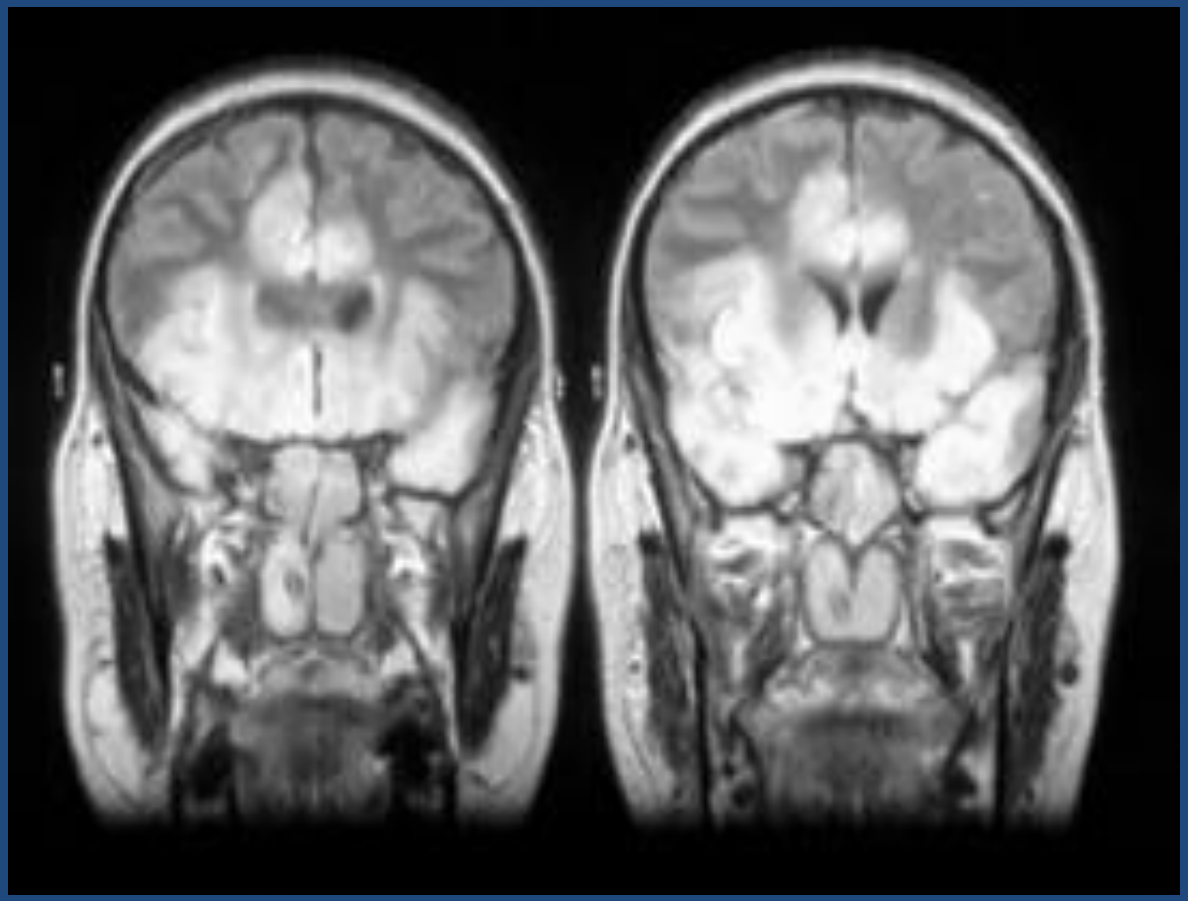
ADEM(CONT)

Features deemed characteristic of ADEM include:

Simultaneous bilateral optic neuritis , loss of consciousness , meningismus , loss of deep tendon reflexes ,fever , myalgia

ADEM(CONT)

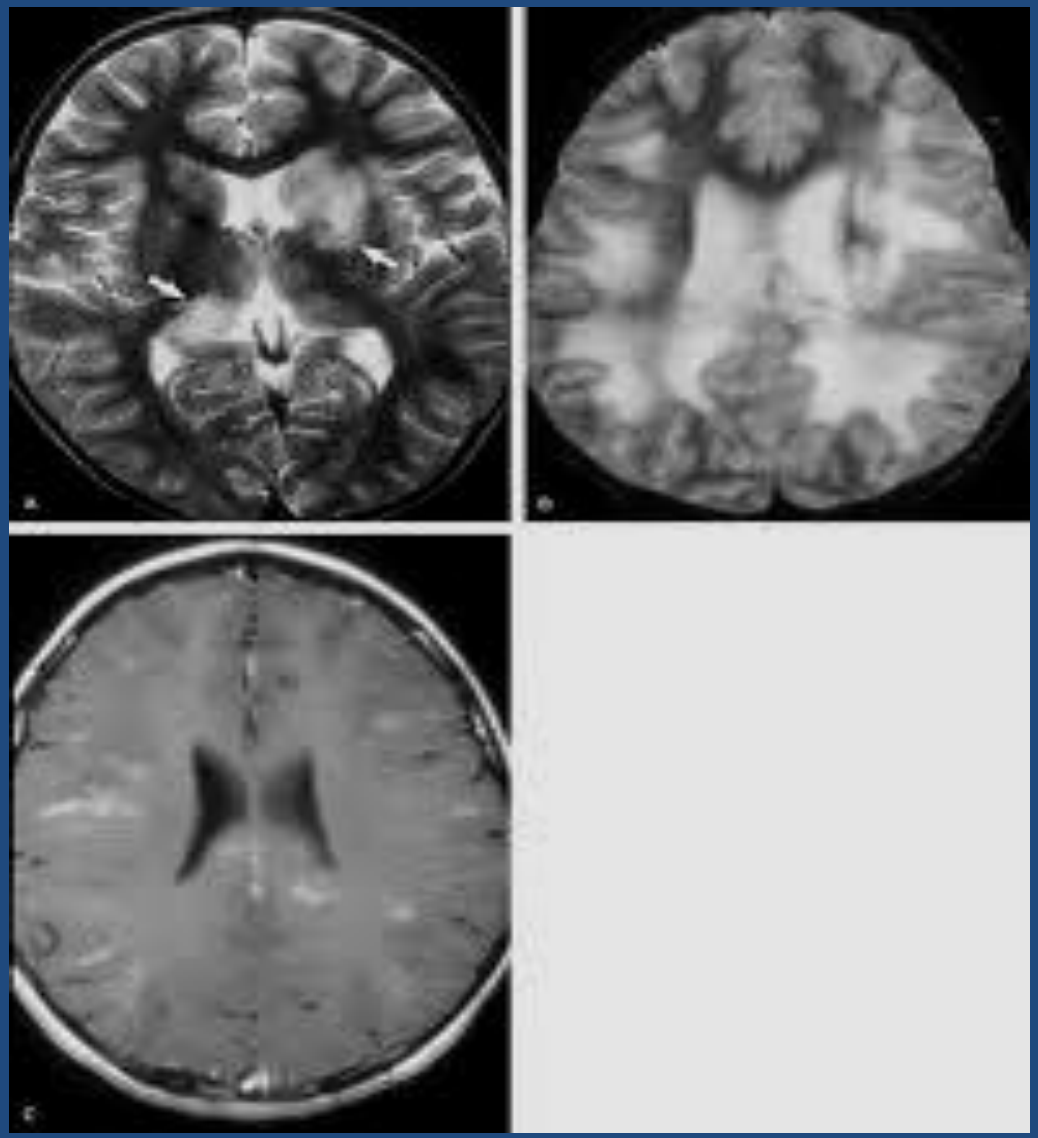
As in MS , ADEM can involve the spinal cord , U fiber and corpus callosum and sometimes show enhancement



ADEM(CONT)

Different from MS is that lesions are often large and in a younger age group.

The disease is monophasic



Spinal cord involvement in ADEM

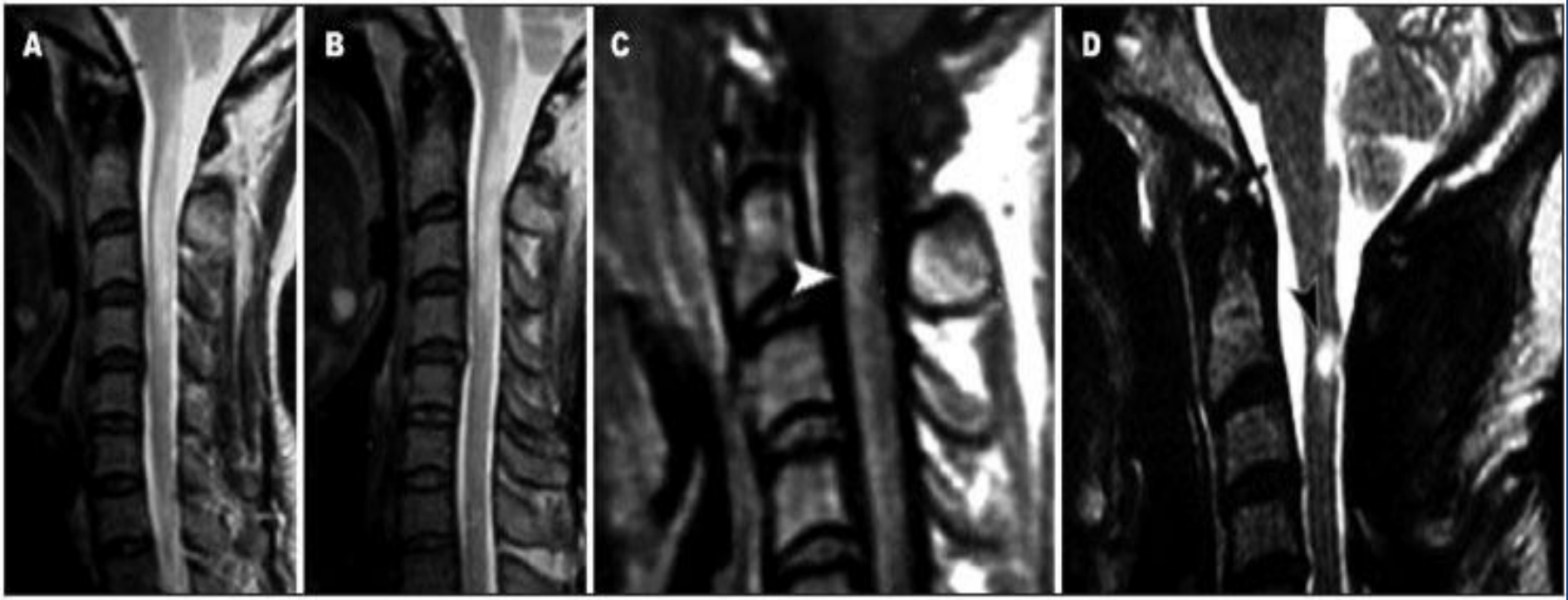
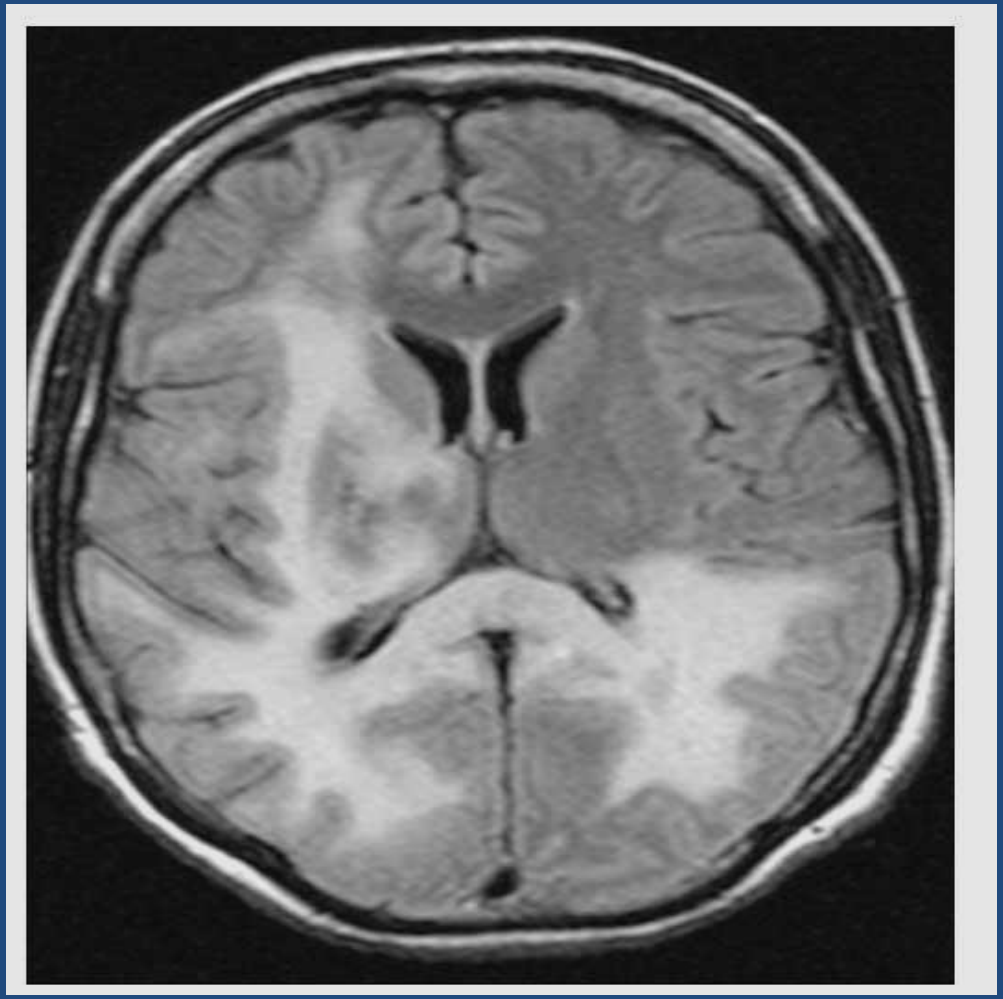


Fig 6. Case 4.A 43-year-old female patient with ADEM. Sagittal T2-weighted [A and B] and T1-weighted after gadolinium administration [C] MR images show a hyperintense lesion extending from the medulla oblongata to the level of C4, which demonstrate an area of contrast enhancement (white arrow-head). The patient underwent a biopsy, which was negative for tumor, and she was treated with corticosteroids with good clinical improvement. The follow-up MR image [D] Sagittal T2-weighted image shows regression of the lesion and the area of malacia (black arrow) secondary to the surgery.

?

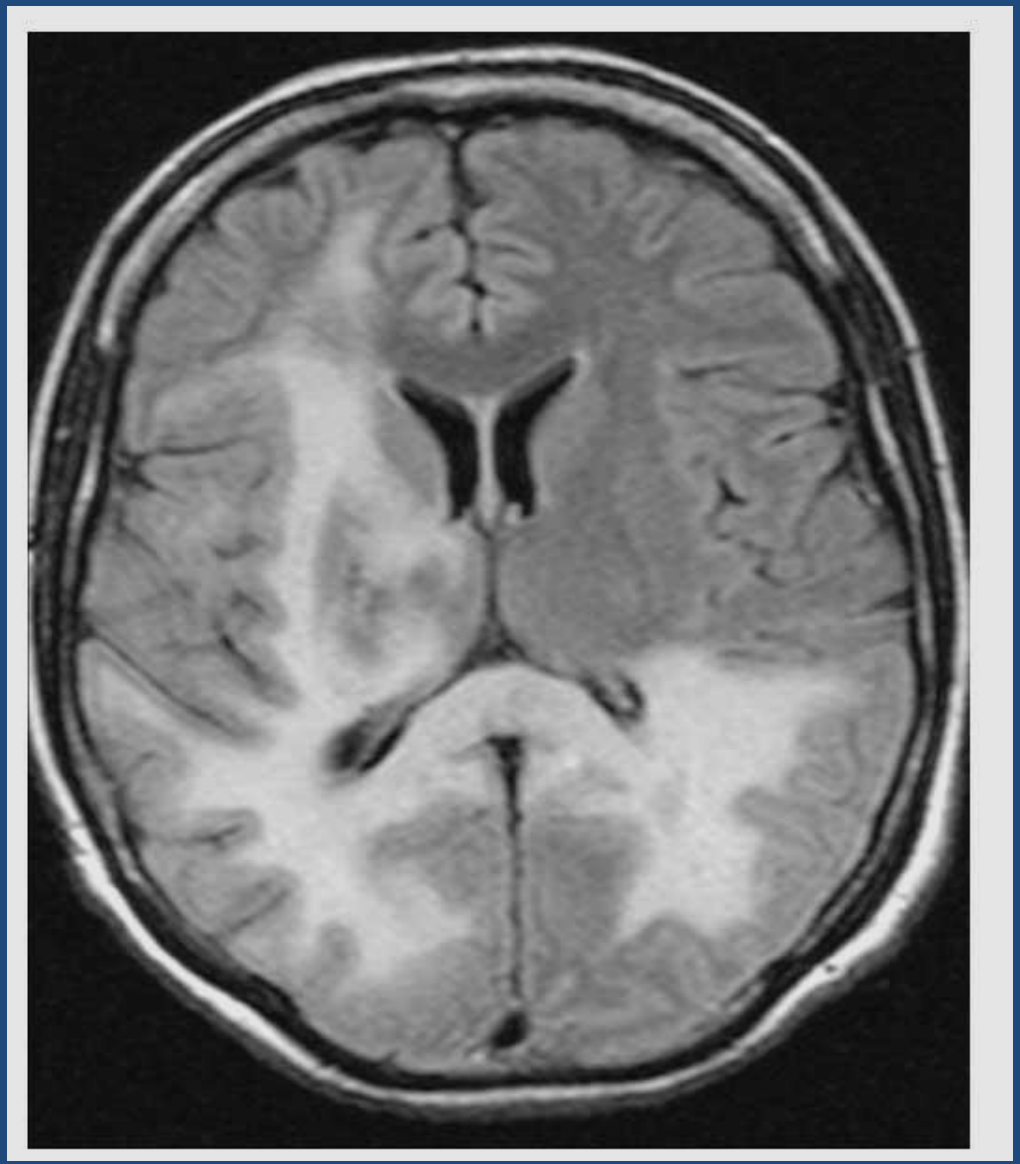
Look at the picture and describe the lesions



Progressive Multifocal Leukoencephalopaty (PML)

PML is caused by reactivation of a common virus in CNS of immune-compromised individual

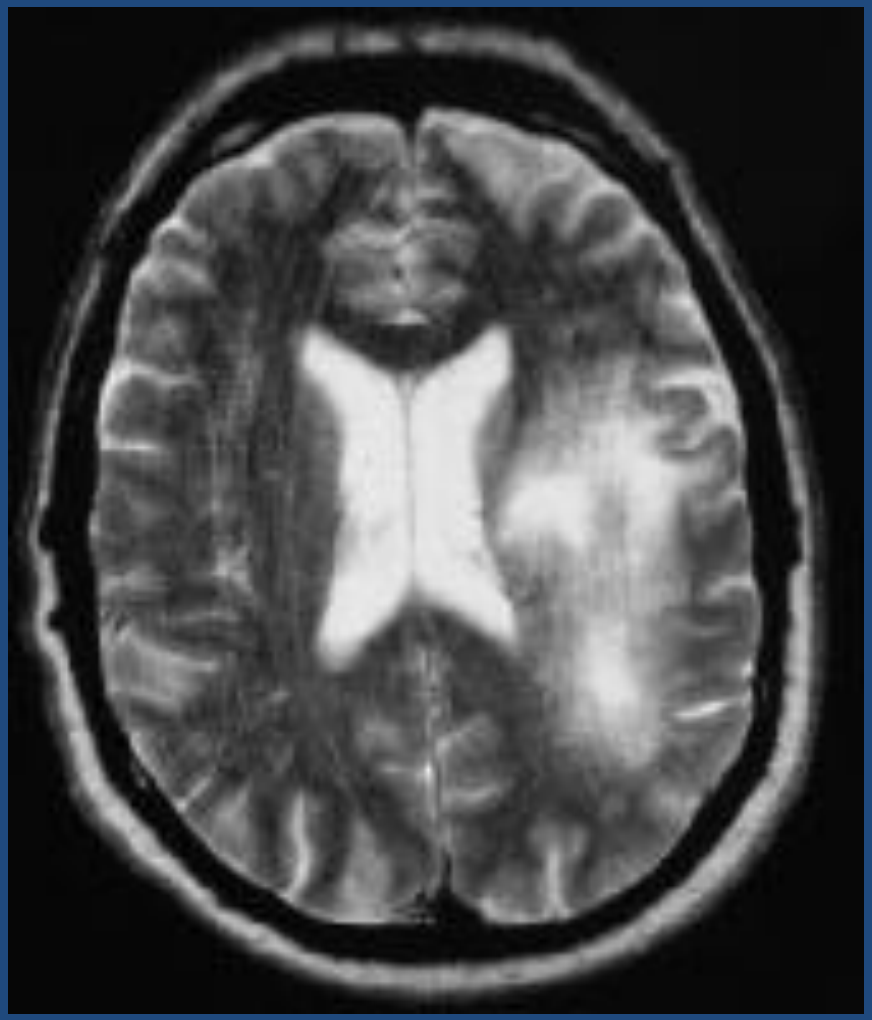
Although disease may involve any part of the brain , lesions typically occur in parieto-occipital lobes



PML(CONT)

T2 W image:

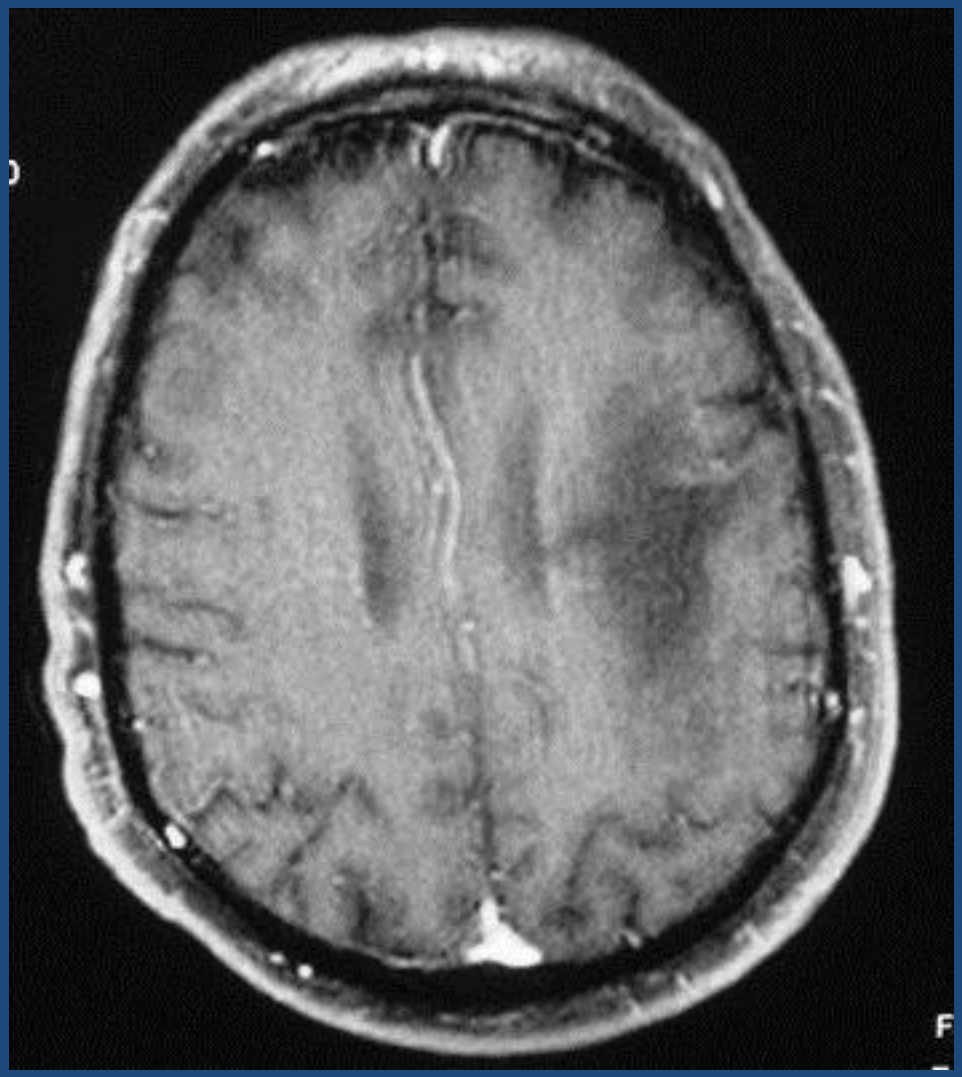
Lesions appear hyperintense and typically involve periventricular,subcortical white matter , having a characteristic scalloped lateral margin when they involve the subcortical white matter



PML(CONT)

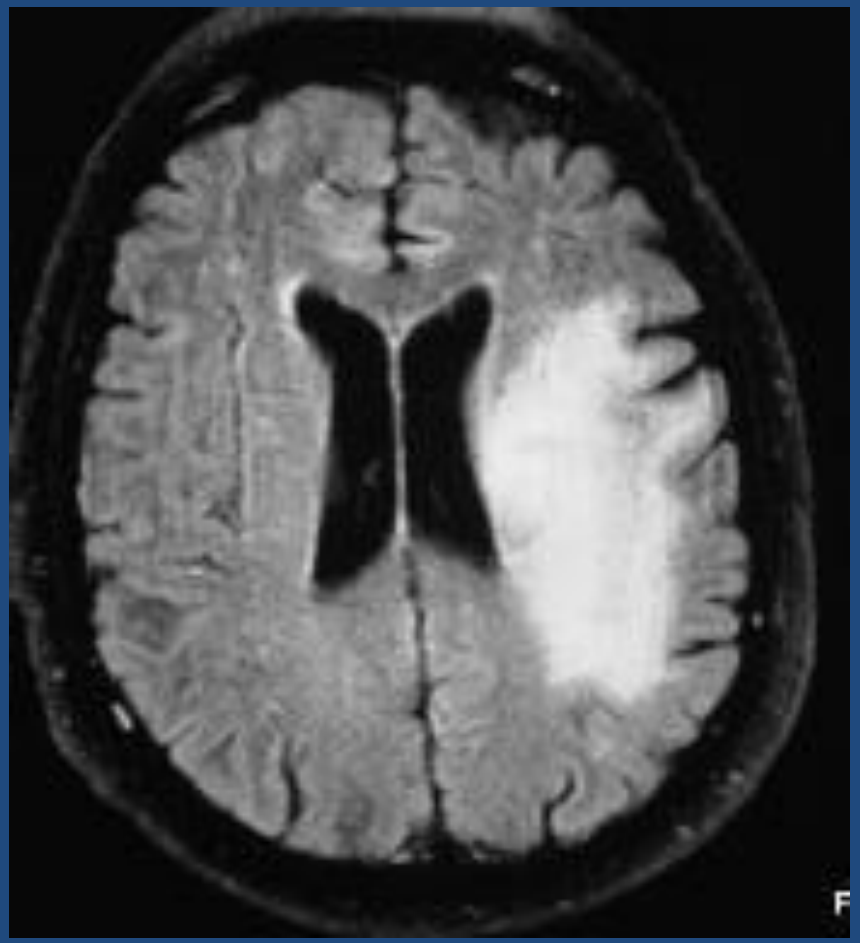
PML,contrast-ebhanced T1

Note the characteristic absence of enhancement and lack of mass effect



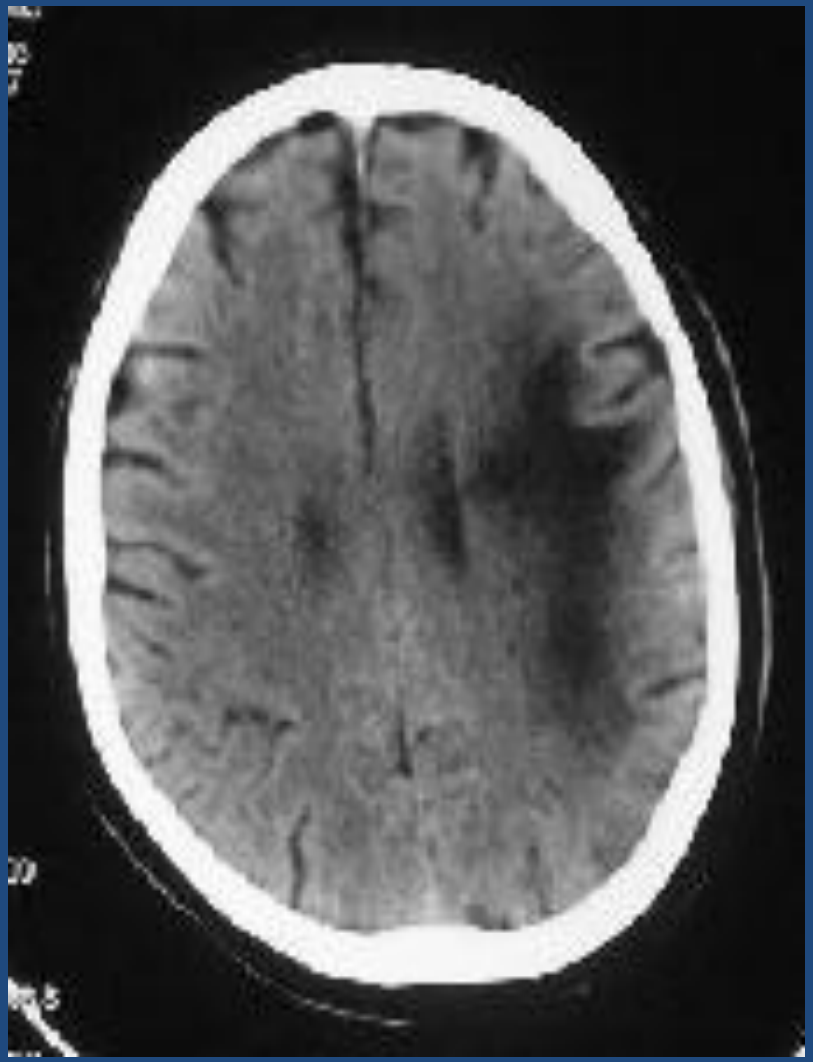
PML(CONT)

FLAIR image



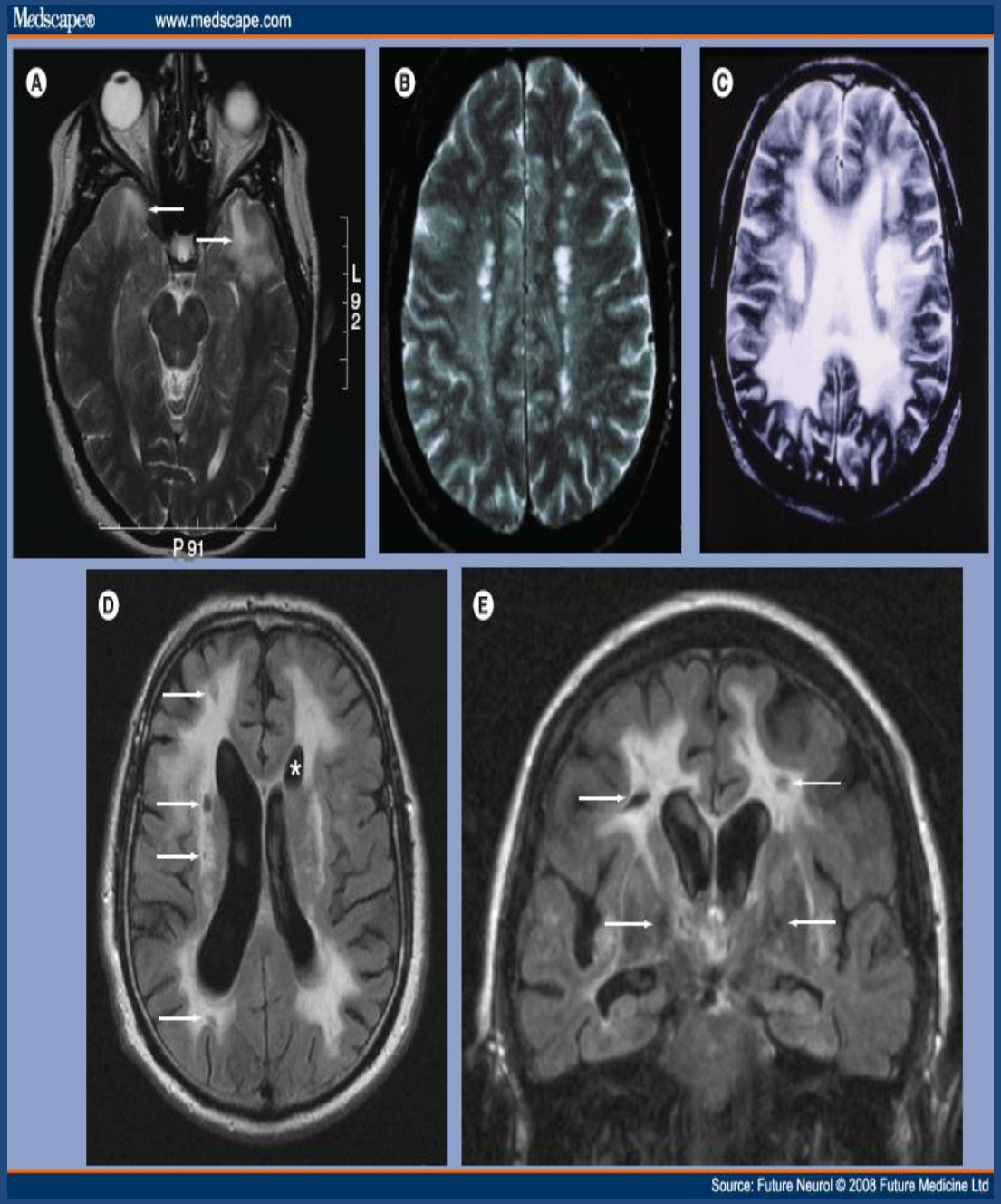
PML(CONT)

Brain ct scan



?

Describe the lesions

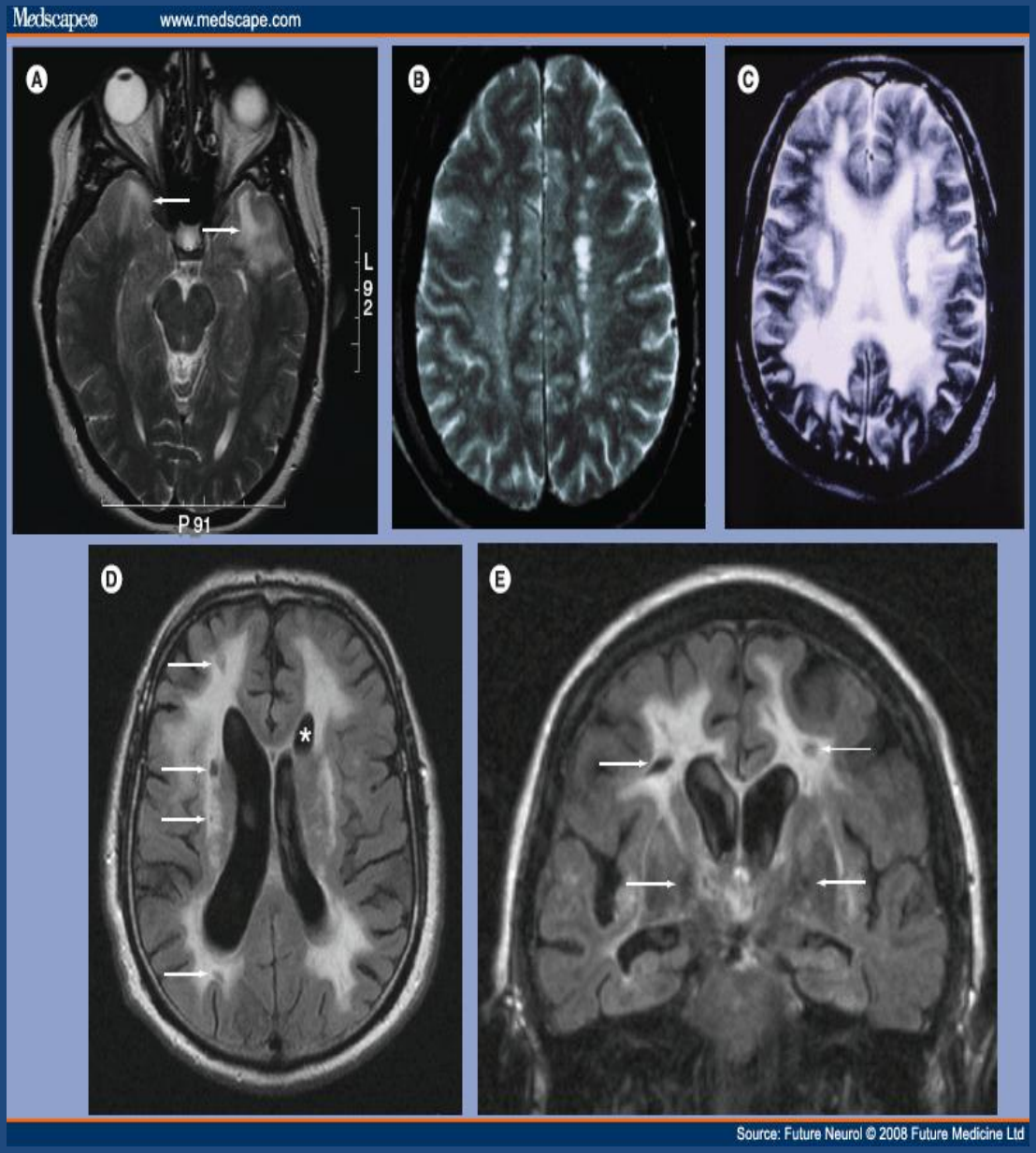


CADASIL

Infarcts are most commonly located in WM and deep gray matter(BG) whereas cerebral cortex remains intact

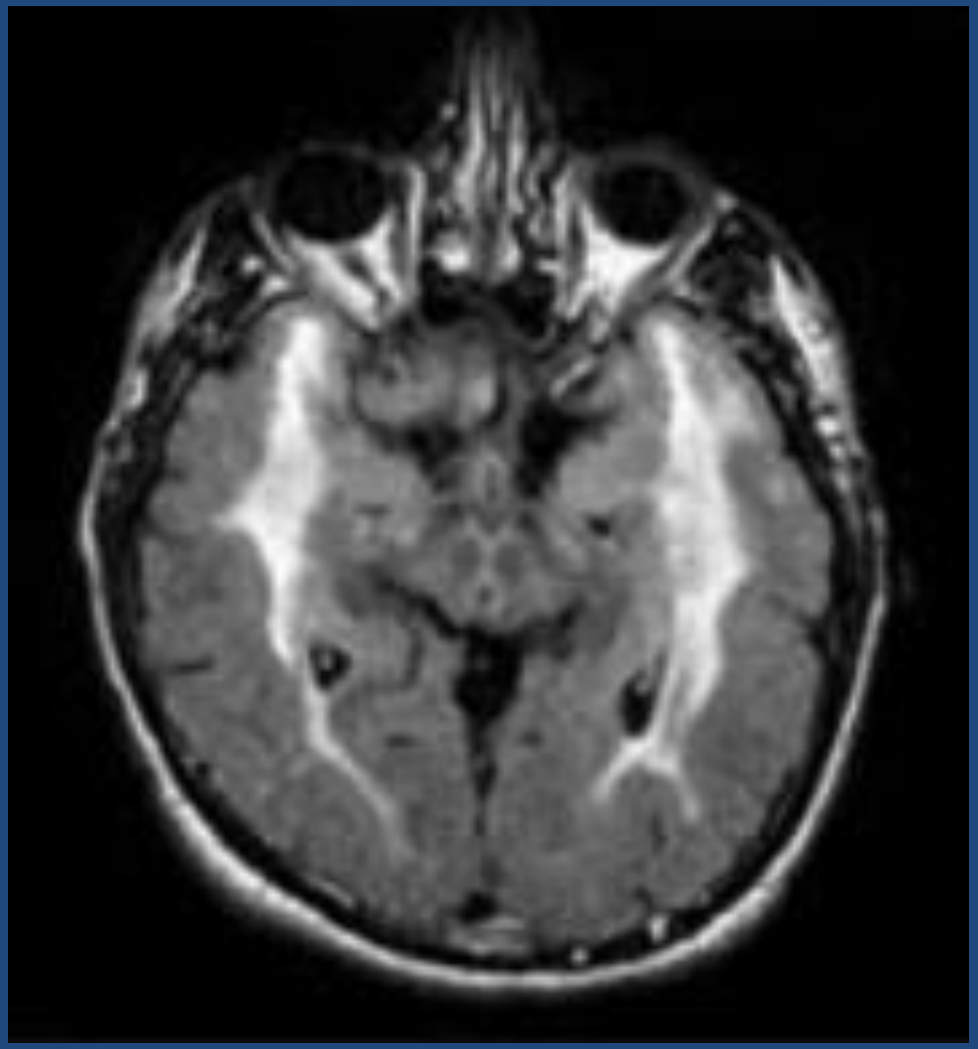
Microbleeds are detectable in 30-70% of the cadasil patients

Microbleeds show preference for cortical-subcortical regions,thalamus and brainstem and are more common in patients with antiaggregant therapy



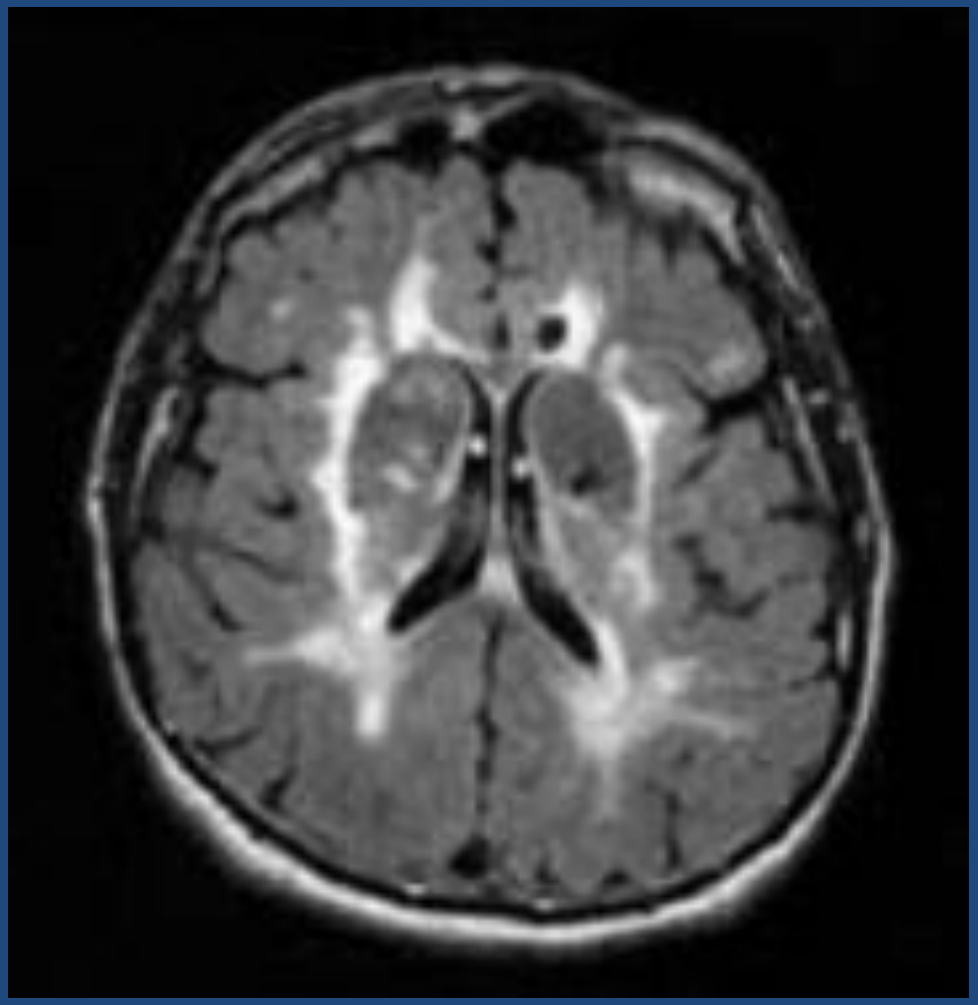
CADASIL

Temporopolar WM involvement in cadasil



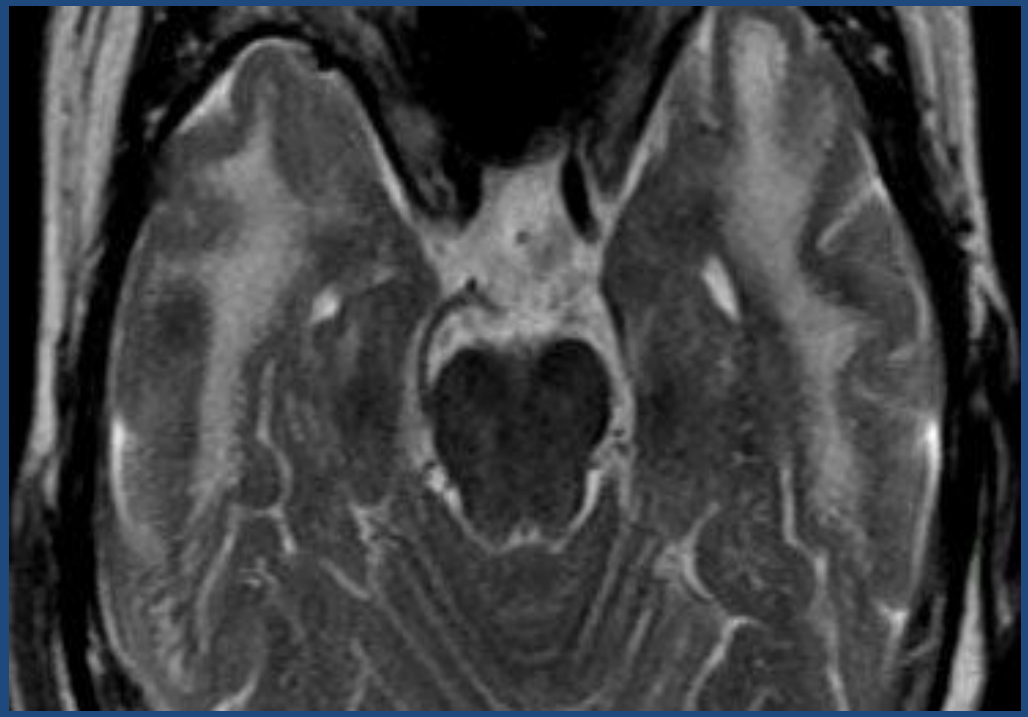
CADASIL

Hyperintensities on T_2 MRI in temporopolar WM, periventricular WM and external capsule are characteristic early finding in cadasil



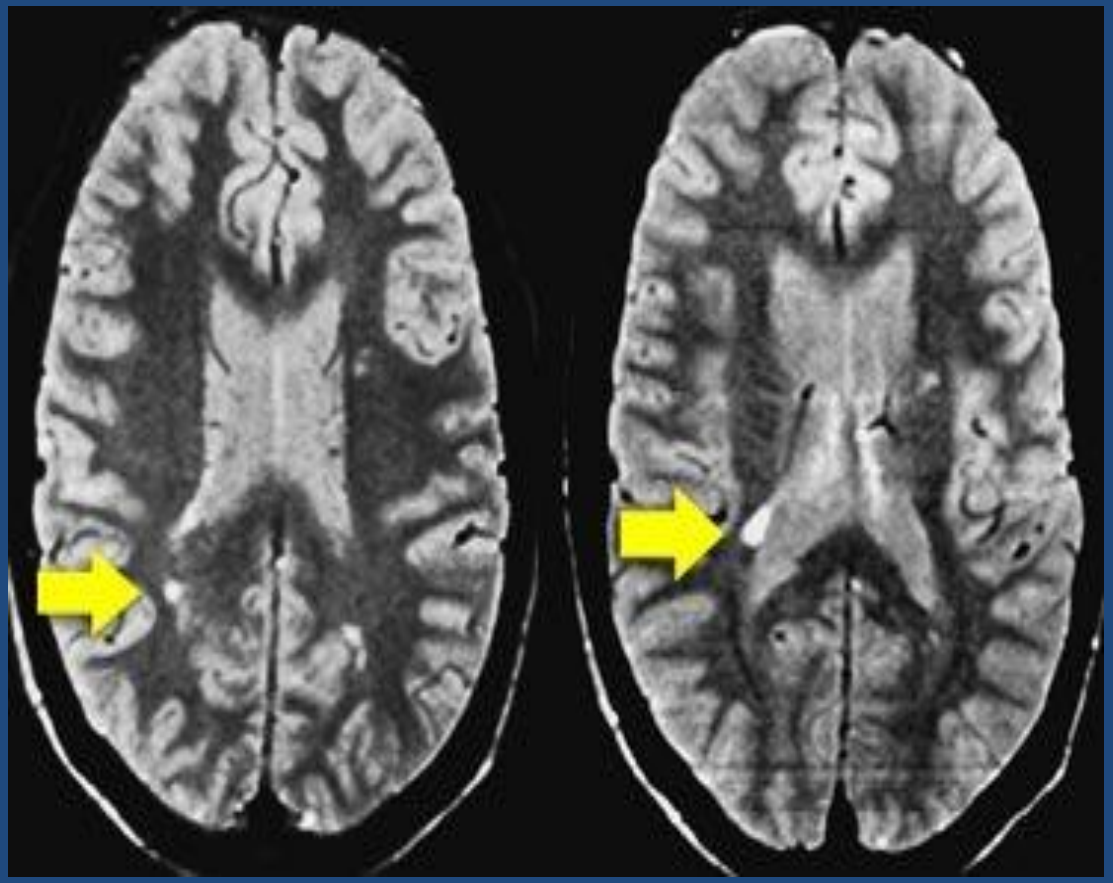
Cadasil(cont)

Anterior temporal pole involvement in cadasil have a high specificity



?

Describe the lesions

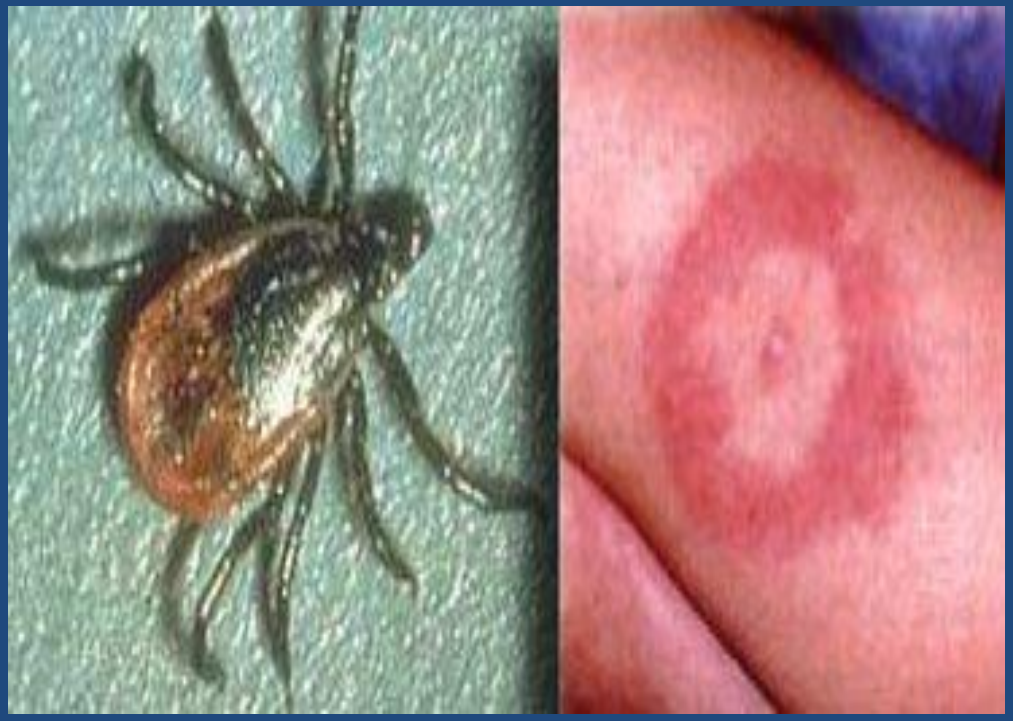


Lyme Disease

Lyme disease is caused by a spirochaet(Borrelia Burgdorferi) that is transmitted by a tick

It first causes a skin rash

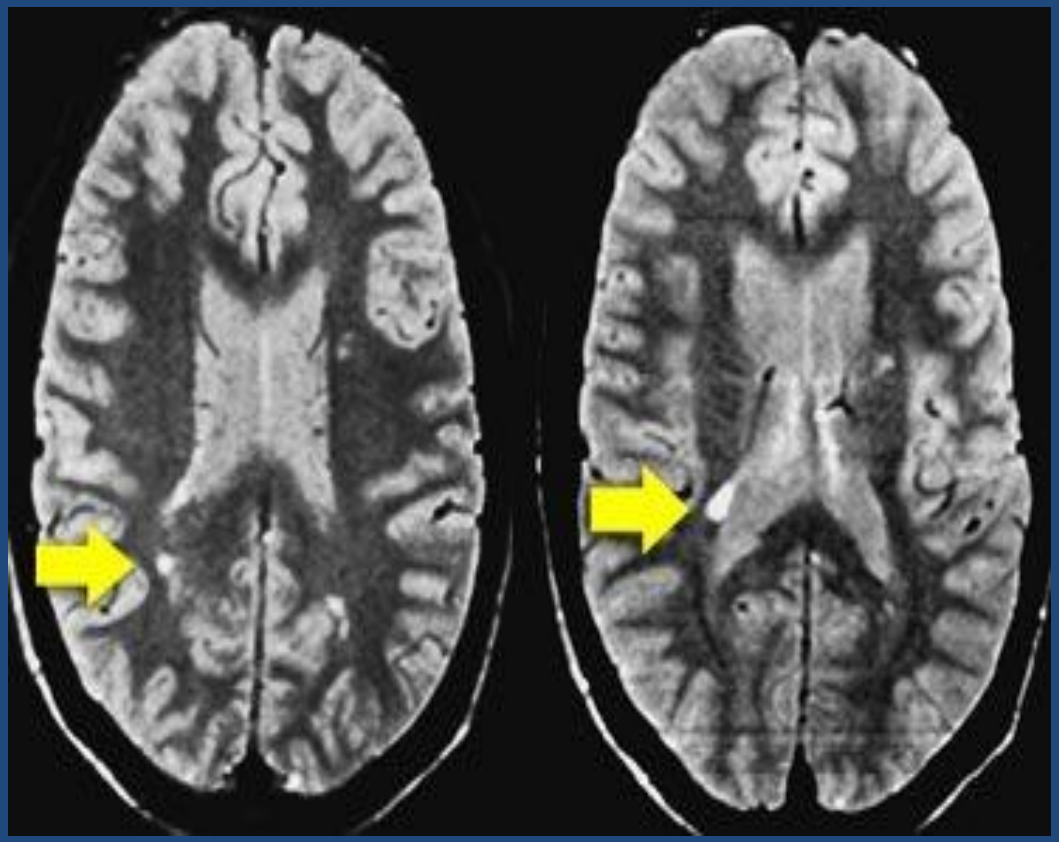
A few months later the spirochaet can infect the CNS and MS –like WMLs are seen



Lyme Disease(cont)

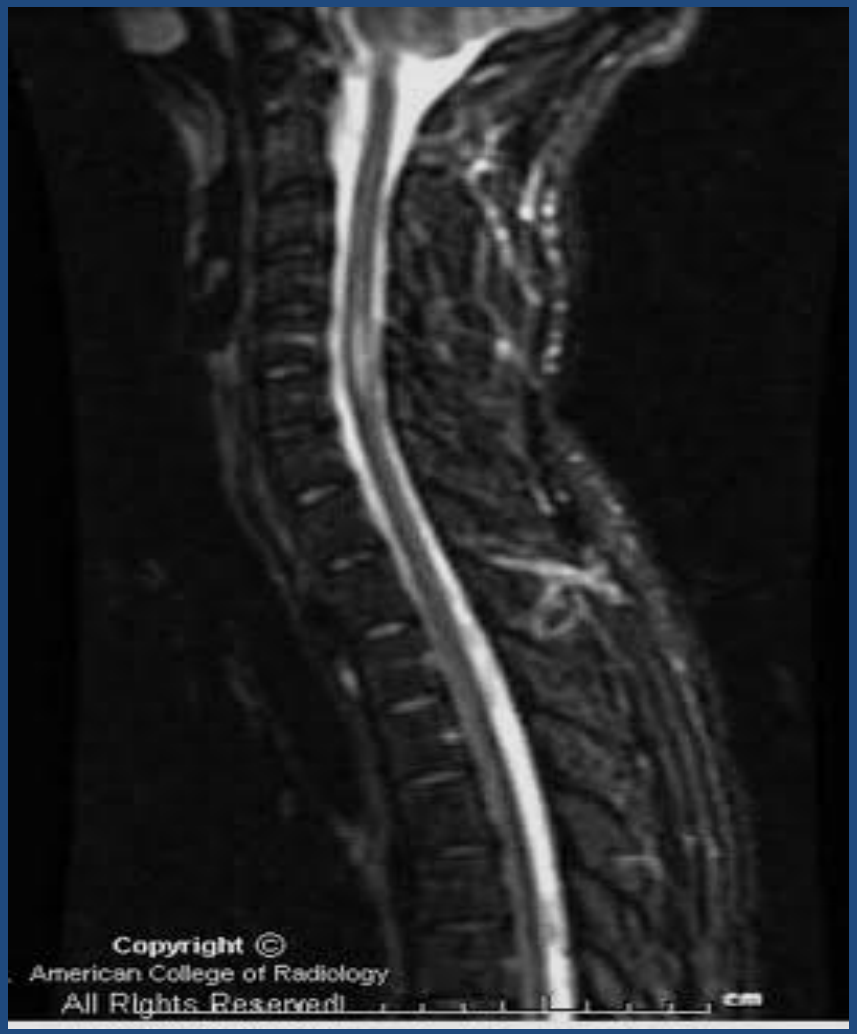
Key finding:2-3 mm lesions simulating MS in a patient with skin rash and influenza- like ilness

Clinically lyme presents with acute CNS symptoms (e.g cranial nerve palsy) and sometimes transverse myelitis



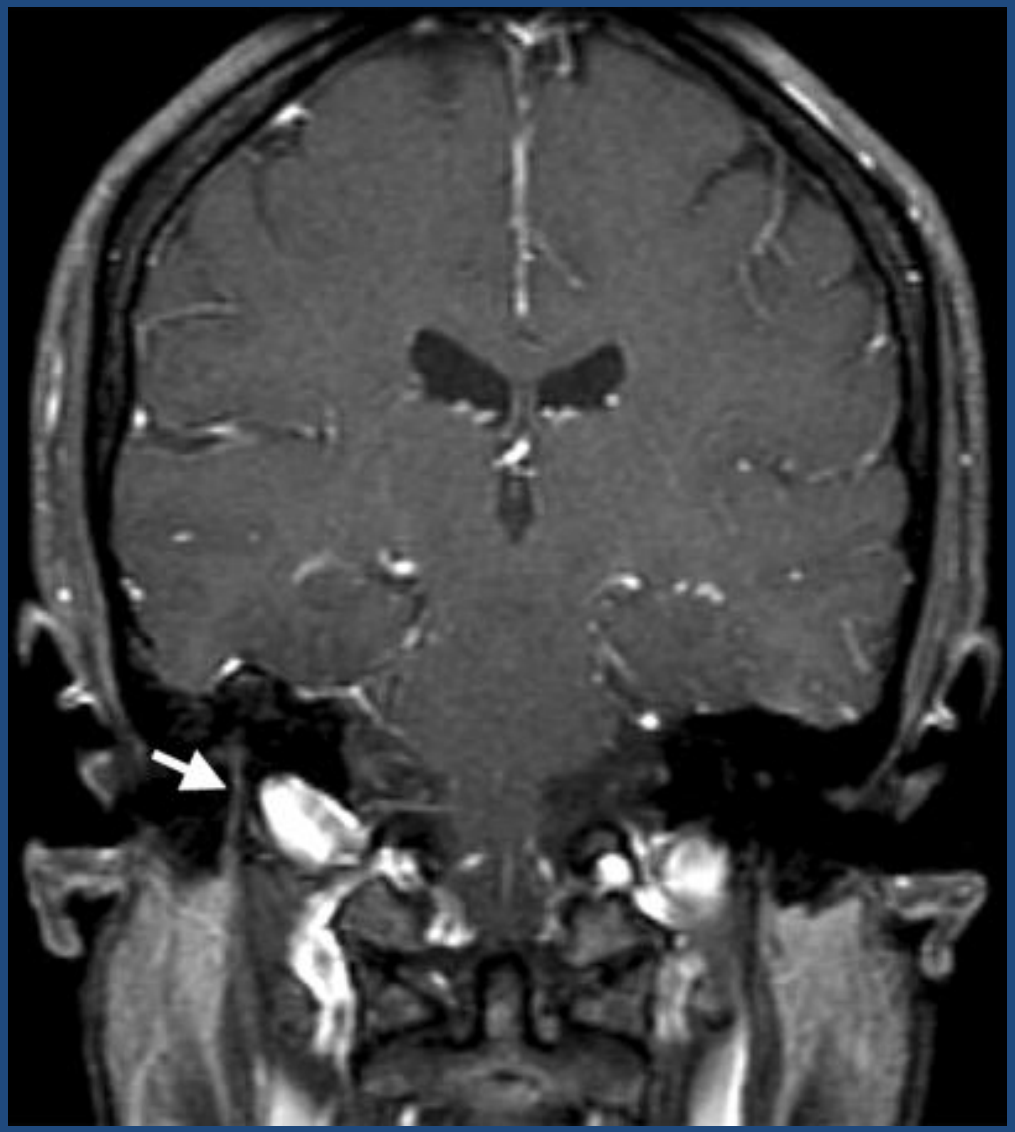
Lyme Disease(cont)

High signal lesion in spinal cord



Lyme Disease(cont)

Enhancement of(CN7)



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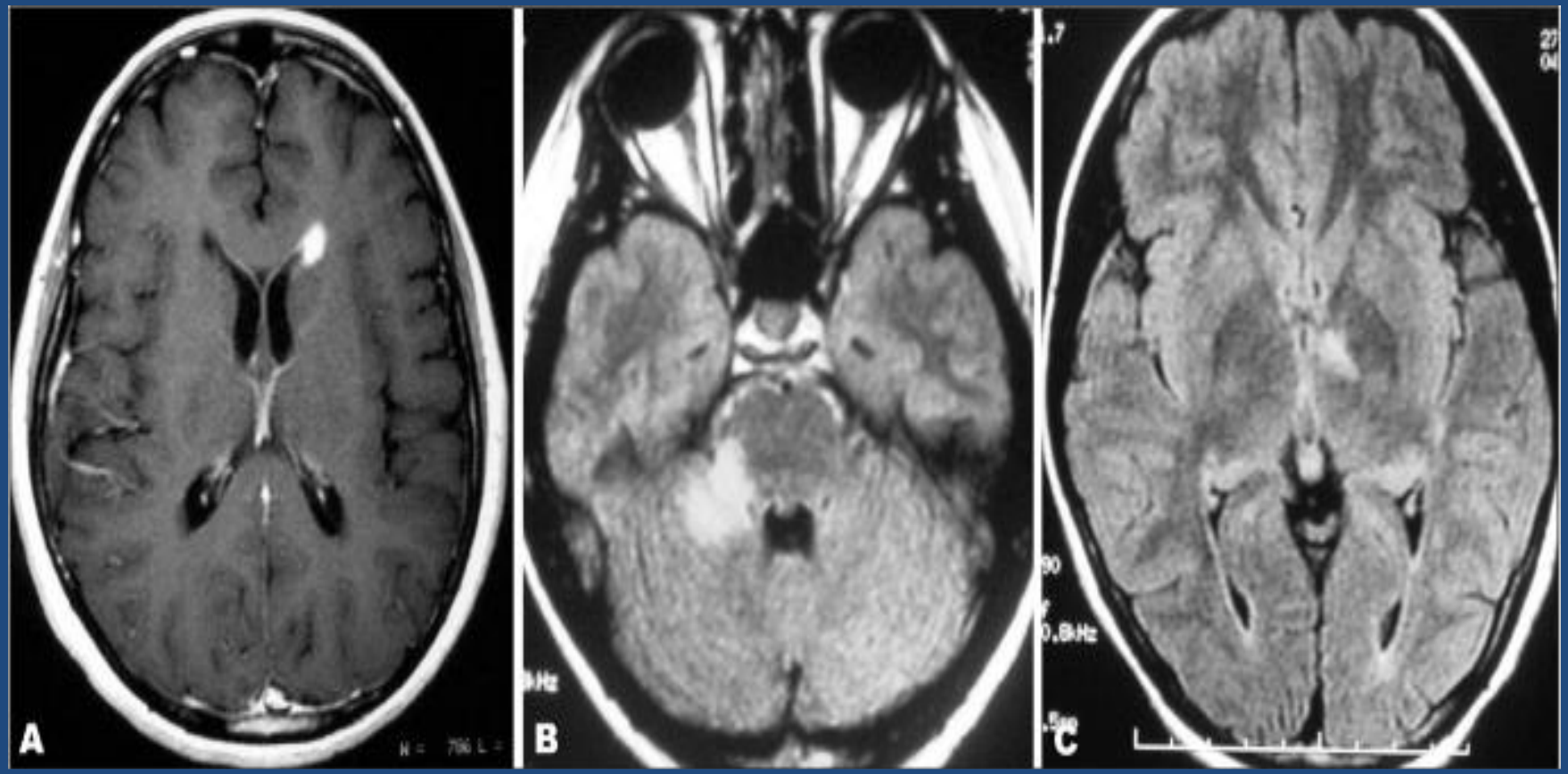

A
B
C

Brain involvement in Devic

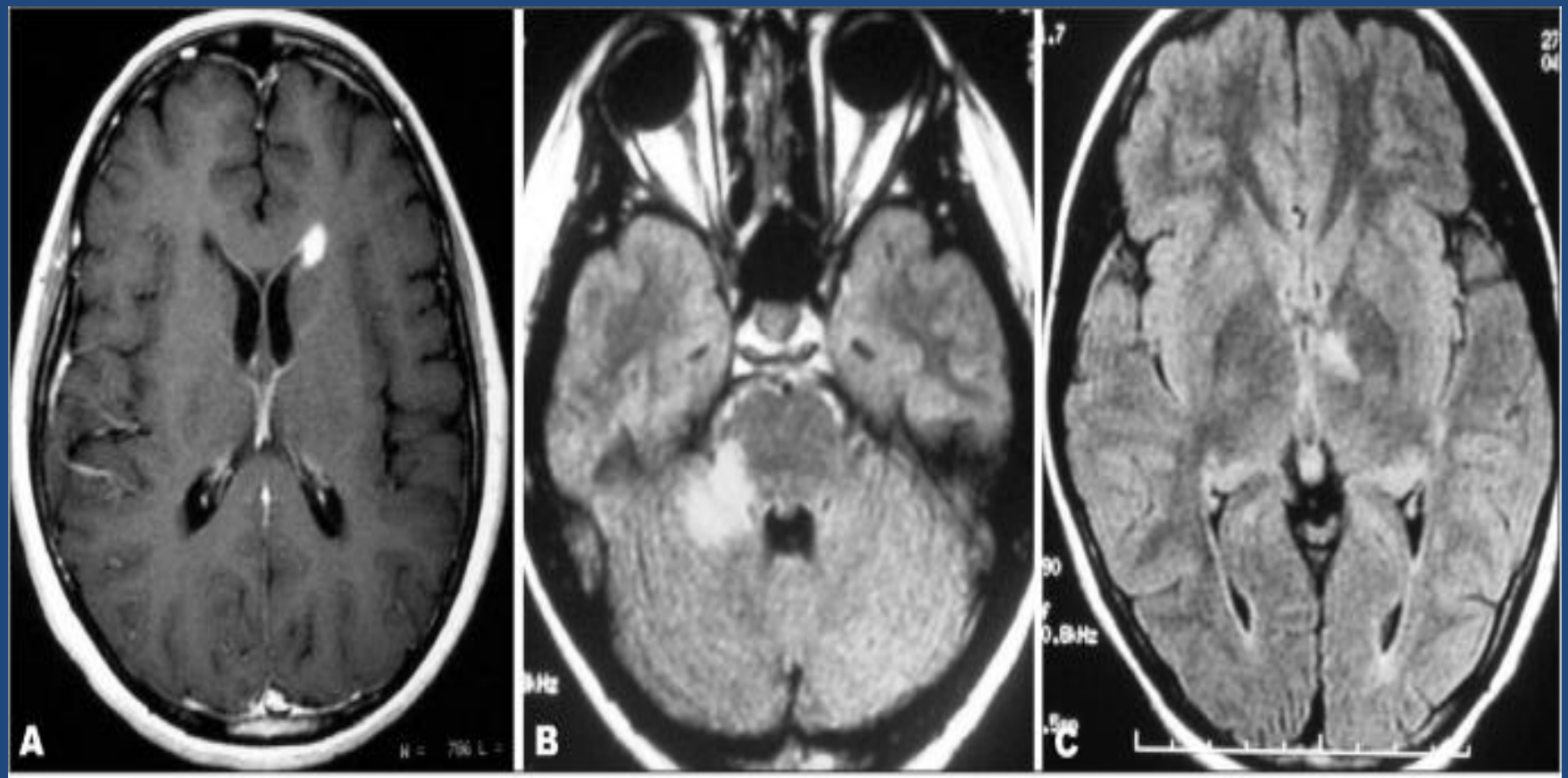


Fig 3. Abnormal brain MRI in patients with neuromyelitis optica. (A) Isolated gadolinium-enhancing periventricular lesion. (B) Tumefactive gadolinium-enhancing lesion involving upper pons and cerebellum. (C) Lesion in the third ventricle region.

Devics Disease(Neuromyelitis Optica)

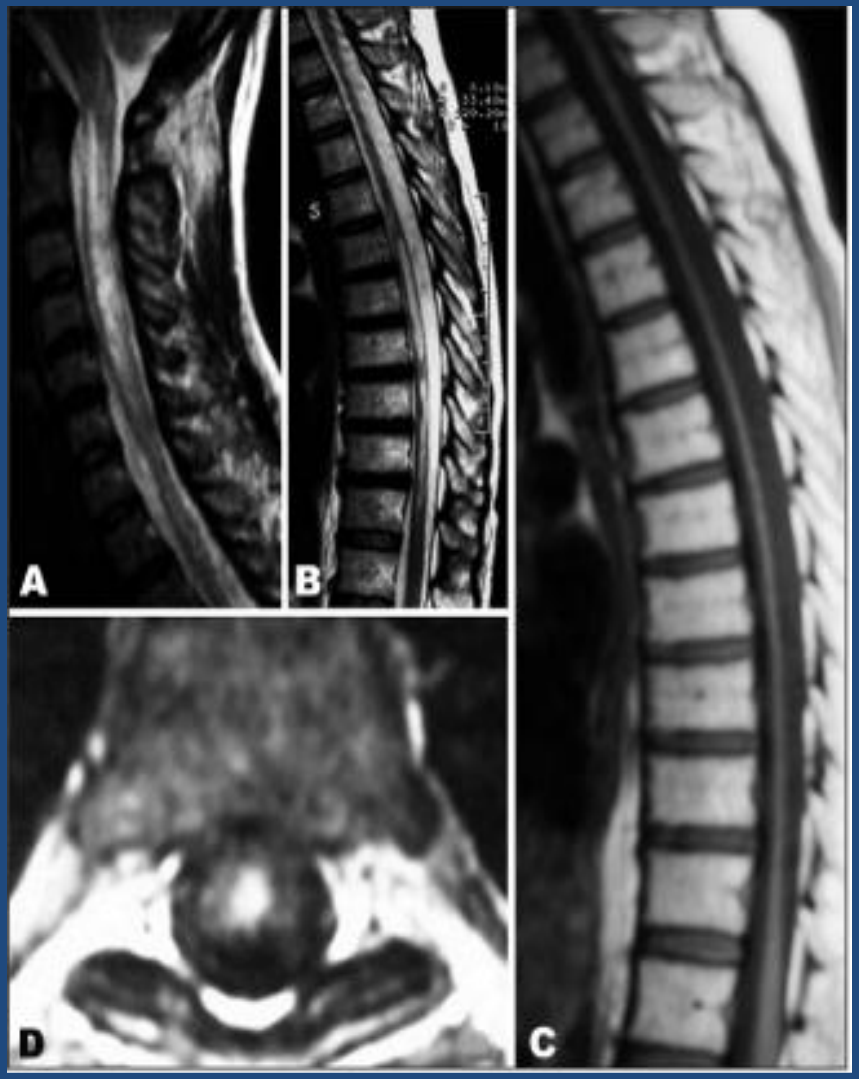
- Devics disease is an inflammatory disorder with a striking predilection for the optic nerves and spinal cord
- Acute transverse myelitis is often its initial manifestation
- The interval between the initial events of O N and myelitis is quite variable (several years in some instance)
- Some patients experience unilateral rather than bilateral O N
- The course may be monophasic or relapsing

Devic

Swollen cervical spinal cord with longitudinally extensive lesion (A)

Axial imaging of thoracic cord showing central pattern of involvement (D)

Extensive atrophy of the thoracic spinal cord in a late stage of the disease (C)



Devics Disease (cont)

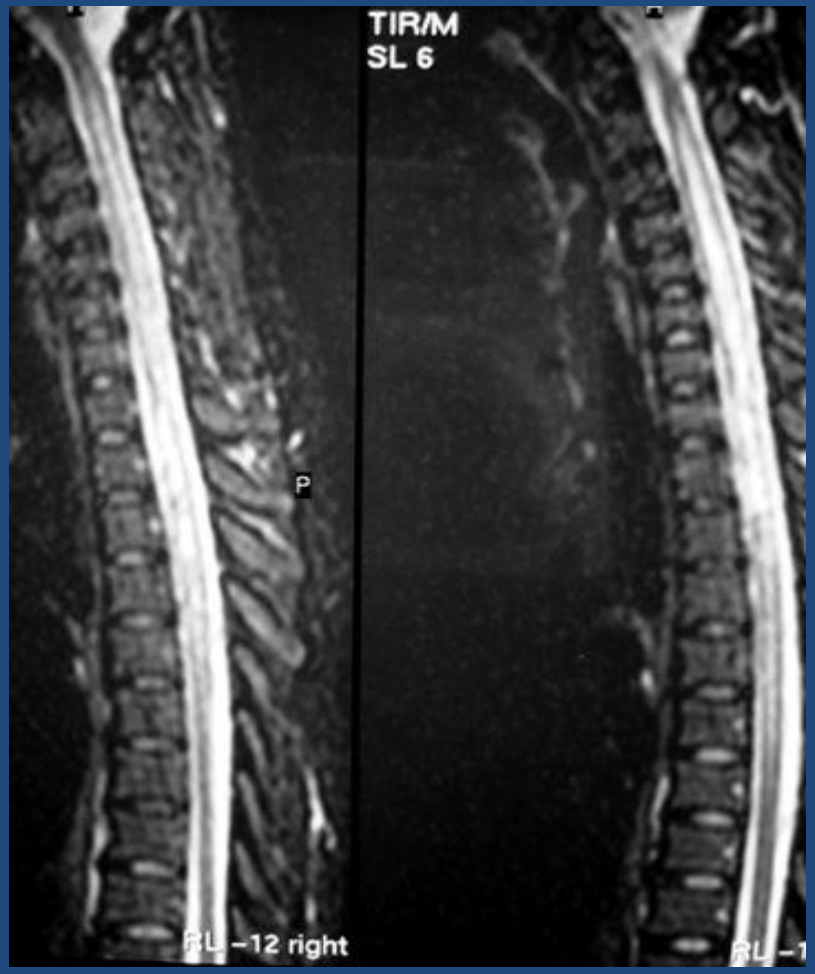
- Diagnosis of NMO is strongly supported by the absence of brain parenchymal lesions or the presence of nonspecific white matter lesions that do not meet radiological criteria for M S. some patients with relapsing disease accumulate white matter lesions over time but these lesions tend to be nonspecific foci that fail to meet radiological criteria for MS
- During acute O N ,brain MRI may demonstrate swelling and/or gadolinium enhancement of an affected optic nerve or the chiasm ,while occasionally more sever and extensive than encountered in MS (involve entire chiasm),these nonspecific findings in the optic nerve do not distinguish NMO from isolated ON or typical MS

Devics Disease(cont)

- Episodes of myelitis in NMO are accompanied by striking spinal cord MRI abnormalities.during acute myelitis, the affected region of the cord is usually expanded and swellen and may enhance with gadolinium

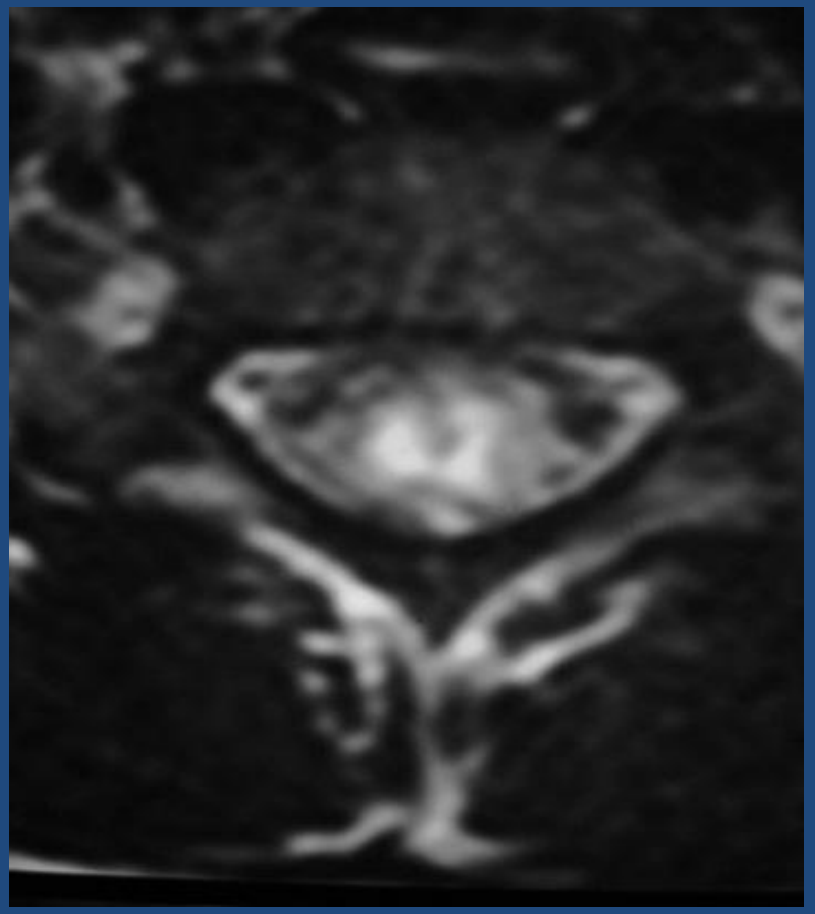
Devic(CONT)

The most distinct aspect of NMO,cord lesion is that , they usually extend over three or more vertebral segments of the cord



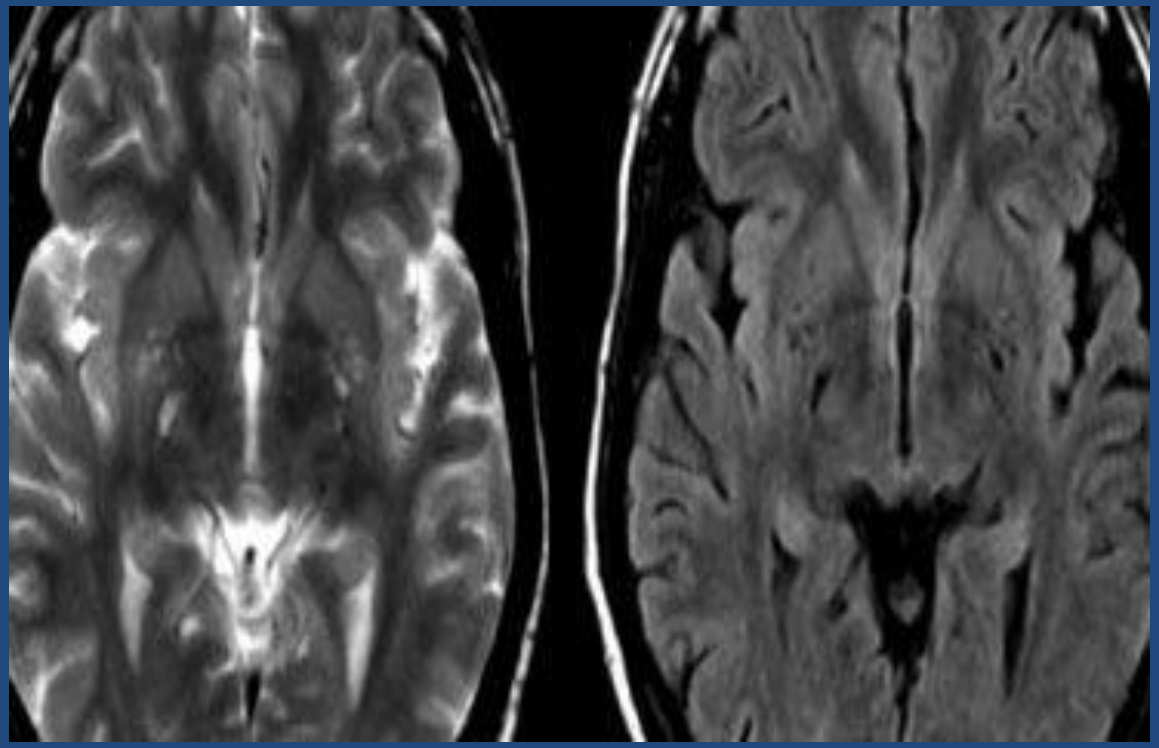
Devic (cont)

Typically the lesions are in the central part of the cord rather than the periphery of the cord as generally occurs in patients with protypic of MS



?

Look at the images and describe the lesions

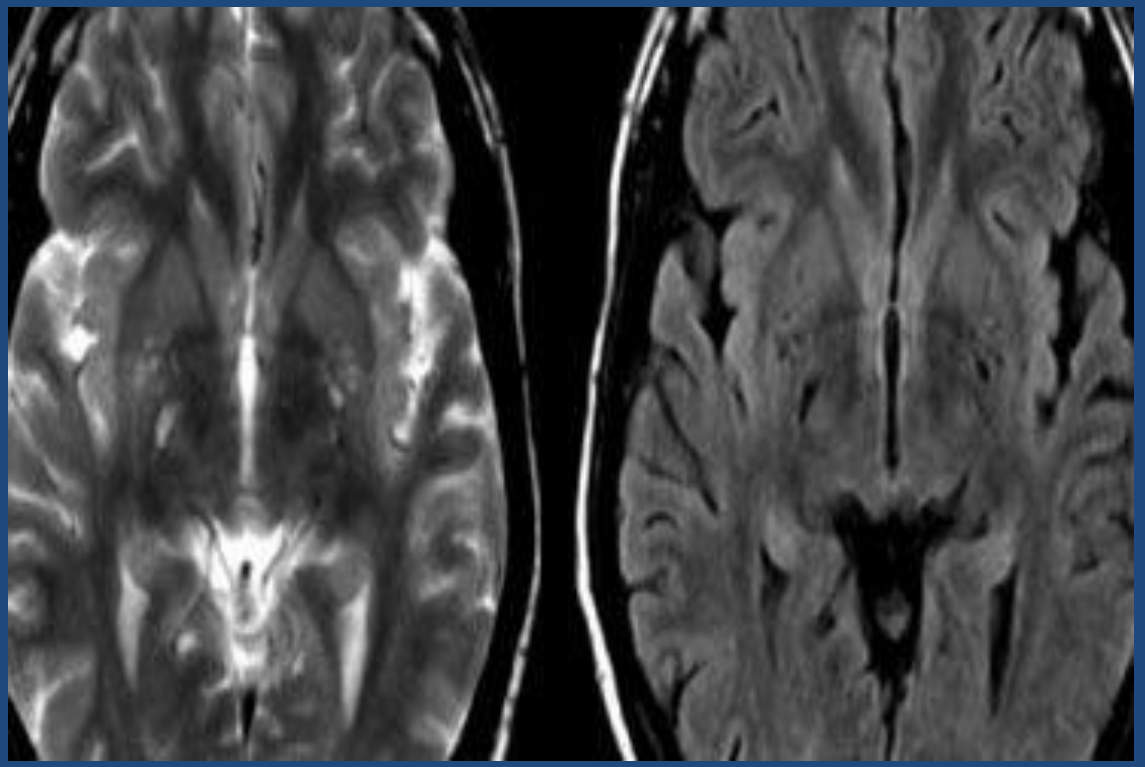


Virshow Robins

T2W images ,there are multiple high intensity in the basal ganglia

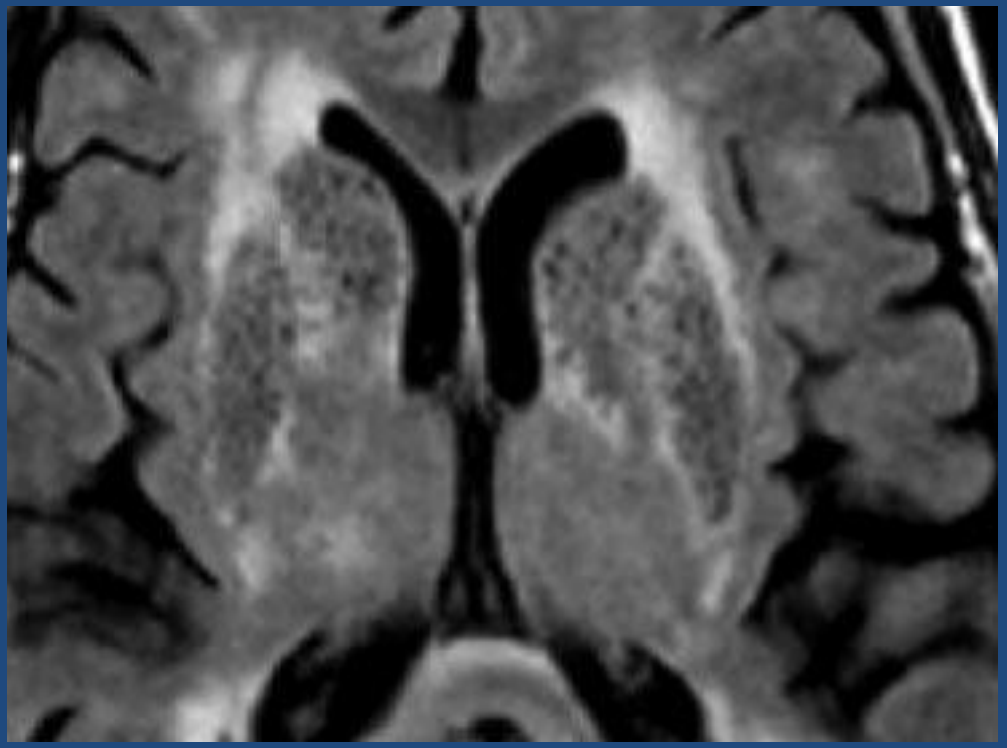
On the flair image these lesions are dark

This signal intensity in combination with the location is typical for Virchow Robins spaces



V R SPACES(CONT)

This case nicely illustrates the difference between VR spaces and WMLs



WMLs prevalence

Hereditary	*uncommon*
Acquired	
- **Lyme**	*1 / 100.000*
- **neuro-SLE**	*5 / 100.000*
- **MS**	*100 / 100.000*
- **vascular**	*5000-50.000 / 100.000*

Conclusion:

- If a patient is suspected of MS and MRI supports the diagnosis do not suggest other uncommon diagnosis in the differential diagnosis

- If a patient is not suspected of MS , and on MRI incidental WML,s are found , do not suggest MS