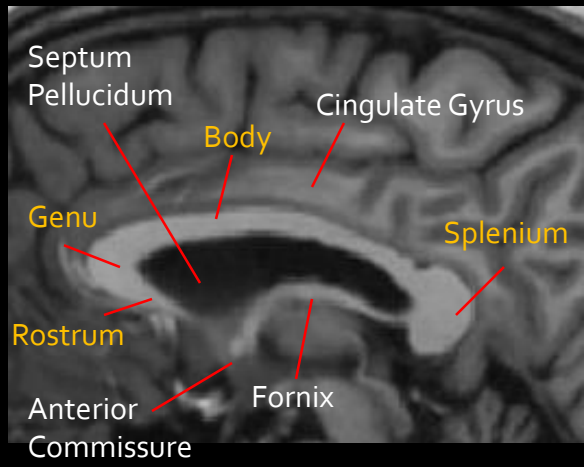
CALLOSAL AND PERICALLOSAL LESIONS

Elizabeth George
5/23/2016

Corpus Callosum Anatomy

- Largest commissural white matter bundle-connects the two hemispheres
- Parts
  - Rostrum: orbital region of frontal lobe
  - Genu: Forceps Minor
  - Body/Trunk: Corona Radiata, tapetum
  - Splenium: Forceps Major
- Relations:
  - Superiorly: Indusium griseum, falx cerebri
  - Inferiorly: Septum pellucidum, Fornix
  - Laterally: Cingulate gyrus



Radiopedia.org; Fitsiori et al, BJR, 2011; 84(997):5-18

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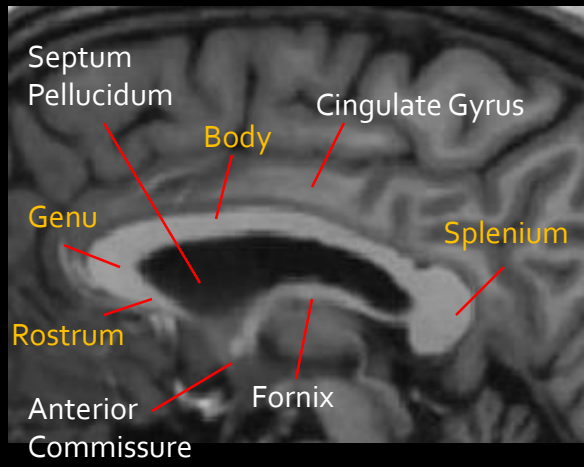

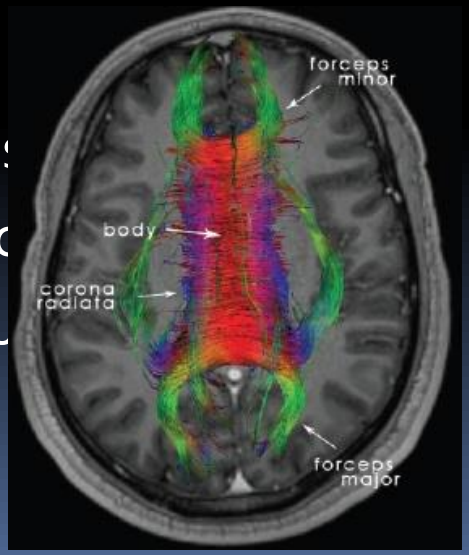

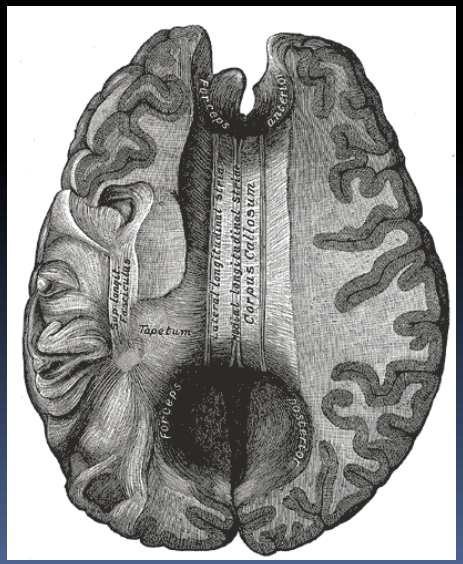

Radiopedia.org; Fitsiori et al, BJR, 2011; 84(997):5-18

Corpus Callosum

- Development
  - Between the 8th and 20th week of gestation
  - Develops anterior to posterior, from genu to splenium, with rostrum forming last
  - Myelination occurs posterior to anterior
- Blood Supply
  - Anterior pericallosal artery-from ACA
  - Posterior pericallosal artery- from PCA
  - Subcallosal or median callosal artery

  - from Acomm

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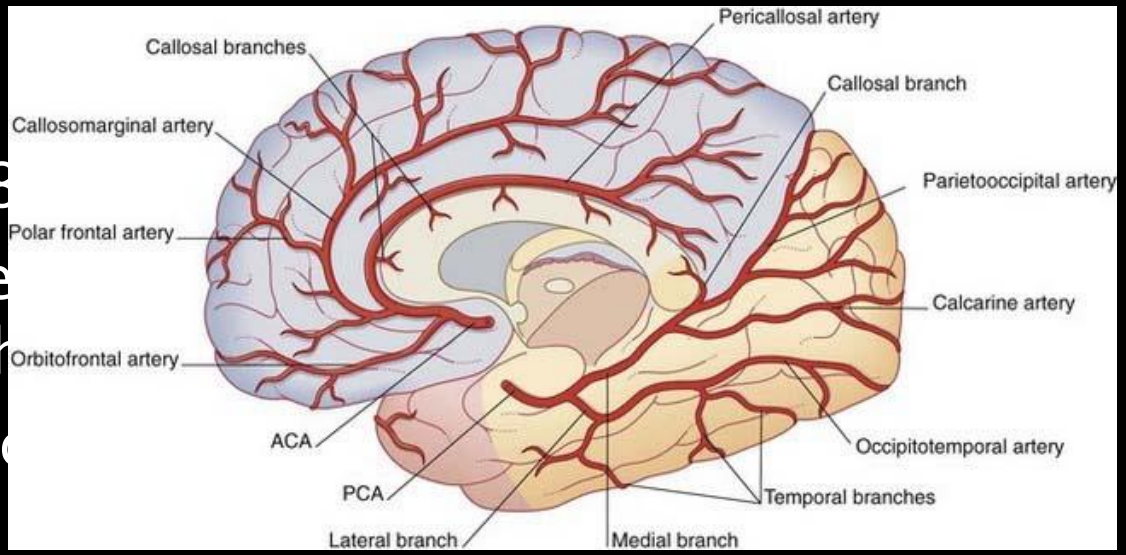


ACR

Variant 5: **Unexplained acute confusion or altered level of consciousness.**

Radiologic Procedure	Rating	Comments	RRL*
MRI head without and with contrast	8	Both CT and MRI may be necessary. CT screens for suspected hemorrhage in the acute setting and MRI screens for infarction and masses. See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI head without contrast	8	Both CT and MRI may be necessary. CT screens for suspected hemorrhage in the acute setting and MRI screens for infarction and masses.	O
CT head without contrast	8	Both CT and MRI may be necessary. CT screens for suspected hemorrhage in the acute setting and MRI screens for infarction and masses.	☢☢☢
MRA head and neck without and with contrast	6	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRA head and neck without contrast	6		O
CTA head and neck with contrast	6	For suspected vascular abnormality.	☢☢☢
CT head without and with contrast	5	If MRI is unavailable or contraindicated. Consider CT perfusion.	☢☢☢
CT head with contrast	4		☢☢☢
MRI functional (fMRI) head without contrast	3		O
MR spectroscopy head without contrast	3		O
FDG-PET/CT head	3		☢☢☢☢
Tc-99m HMPAO SPECT head	3		☢☢☢☢
Thallium-201 SPECT head	3		☢☢☢☢
CT head perfusion with contrast	3		☢☢☢
MRI head perfusion with contrast	3		O
Arteriography cervicocerebral	2		☢☢☢

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

ACR

Variant 1: **Single focal neurologic deficit, acute onset, stable or incompletely resolving.**

Radiologic Procedure	Rating	Comments	RRL*
MRI head without and with contrast	8	Both CT and MRI may be necessary. CT screens for suspected hemorrhage in the acute setting and MRI screens for infarction and masses. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT head without contrast	8	Both CT and MRI may be necessary. CT screens for suspected hemorrhage in the acute setting and MRI screens for infarction and masses.	☢☢☢
MRI head without contrast	7		O
MRA head and neck without and with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRA head and neck without contrast	7		O
CTA head and neck with contrast	7		☢☢☢
CT head perfusion with contrast	7		☢☢☢
MRI head perfusion with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	O
CT head without and with contrast	5	If MRI is unavailable or contraindicated. Consider CT perfusion.	☢☢☢
CT head with contrast	4		☢☢☢
MR spectroscopy head without contrast	4		O
MRI functional (fMRI) head without contrast	3		O
Tc-99m HMPAO SPECT head	3	For problem solving in HIV/AIDS.	☢☢☢☢
Arteriography cervicocerebral	3	For problem solving.	☢☢☢
FDG-PET/CT head	2		☢☢☢☢
Thallium-201 SPECT head	2	For problem solving in HIV/AIDS.	☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

ACR

Variant 4: **New-onset seizure. Unrelated to trauma. Older than age 40.**

Radiologic Procedure	Rating	Comments	RRL*
MRI head without and with contrast	8	In the acute or emergency setting, CT may be the imaging study of choice. See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI head without contrast	7	In the acute or emergency setting, CT may be the imaging study of choice.	O
CT head without contrast	7	In the acute or emergency setting, CT may be the imaging study of choice.	☢☢☢
CT head with contrast	6	In the acute or emergency setting, CT may be the imaging study of choice.	☢☢☢
CT head without and with contrast	5		☢☢☢
Tc-99m HMPAO SPECT head ictal	4		☢☢☢☢
FDG-PET/CT head	4		☢☢☢☢
MRI functional (fMRI) head without contrast	2		O
MEG	2		O

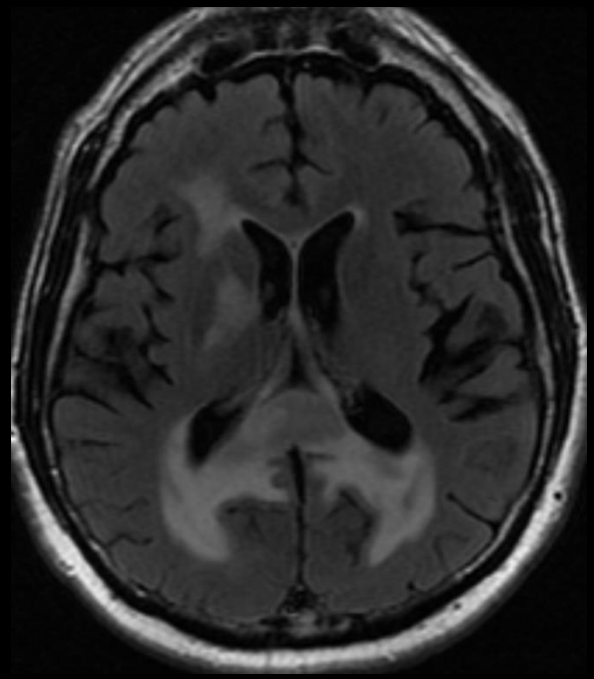
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

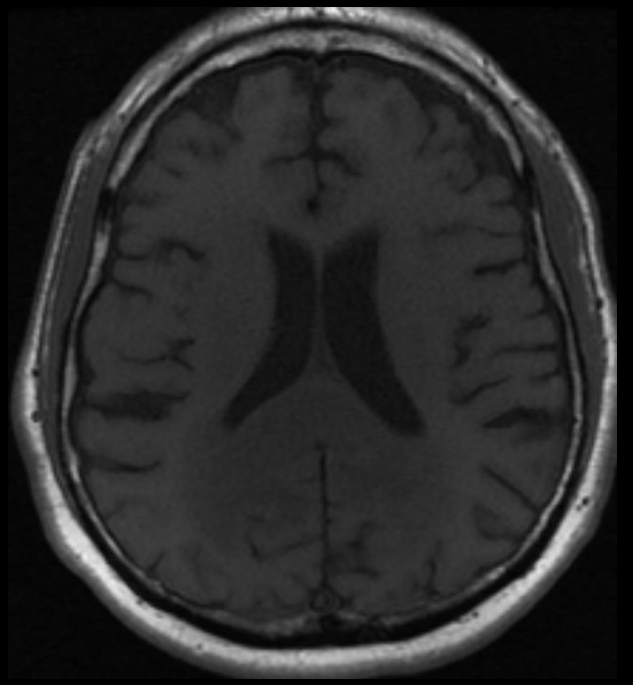
*Relative Radiation Level

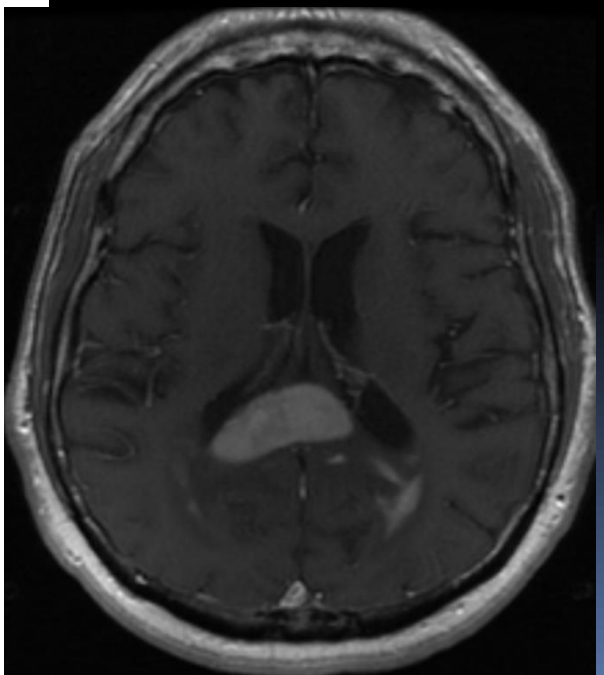
Case 1

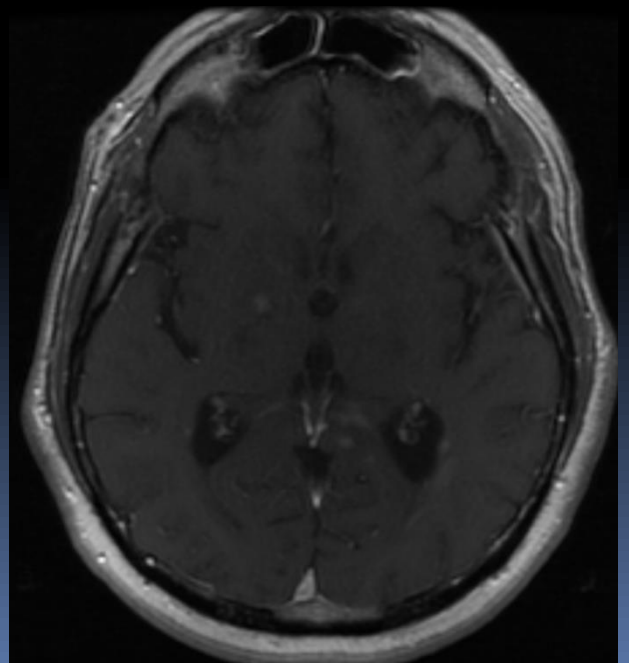
68 y/o right handed male with h/o depression and migraine, presenting with altered mental status, short-term memory loss, and headache

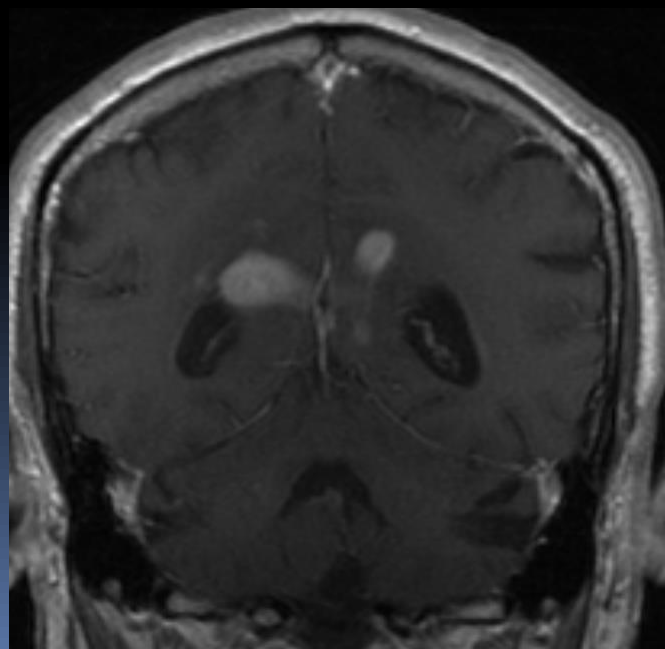
Case 1



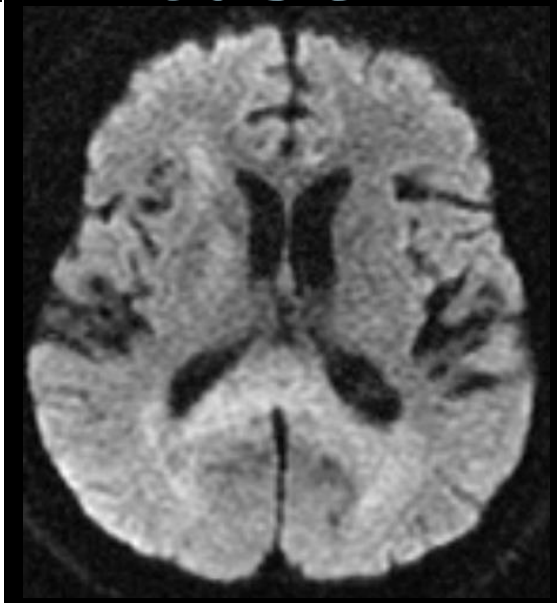


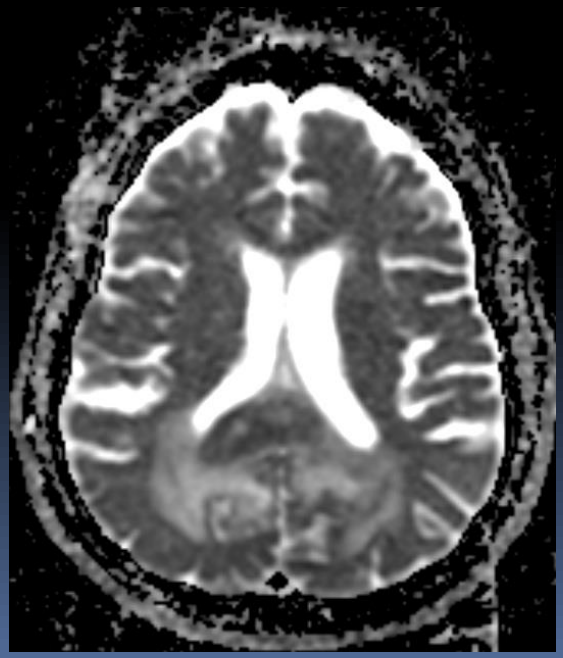






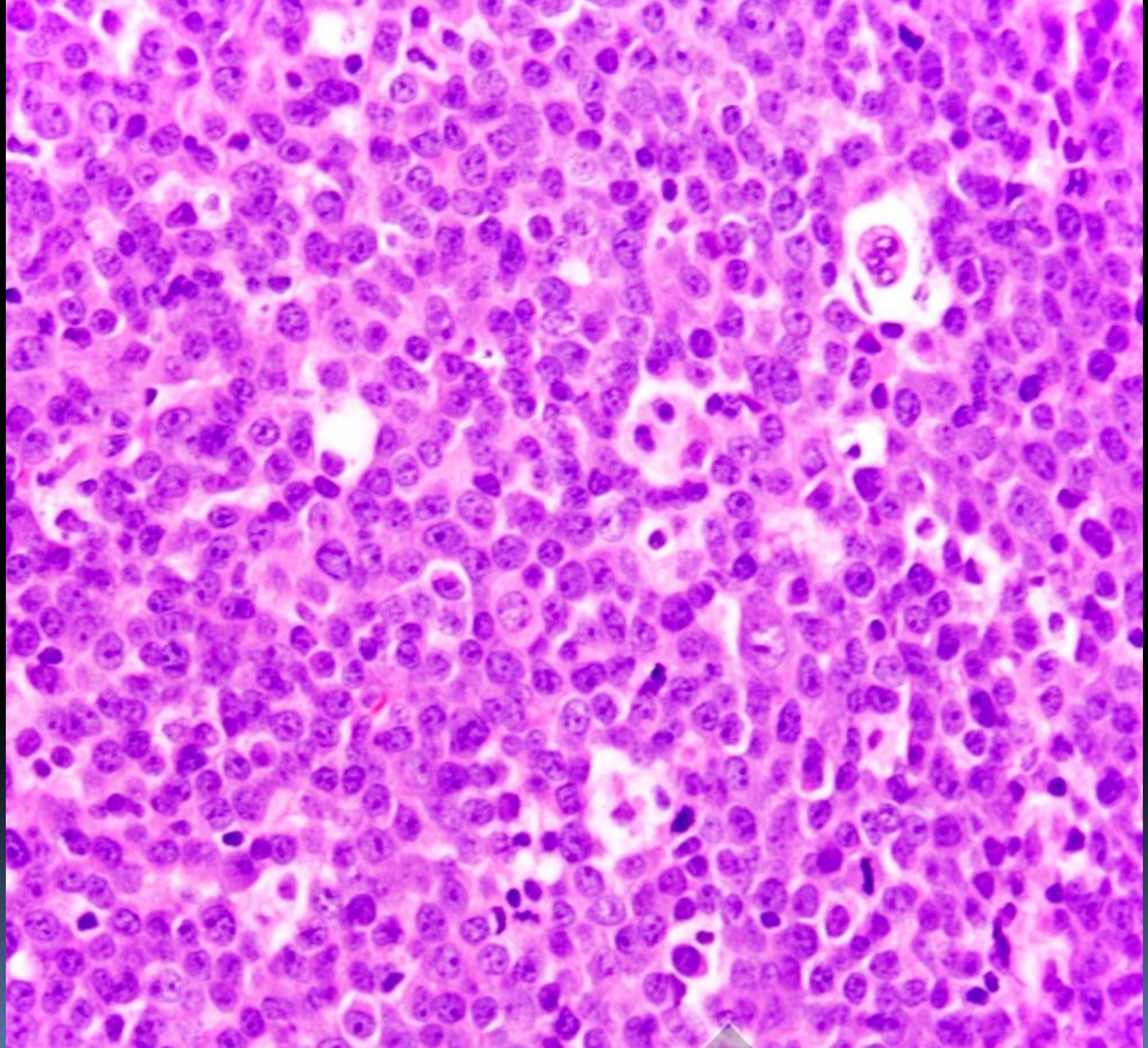
Case 1





Differential Diagnosis

- Lymphoma
- Glioblastoma multiforme
- Metastases



Additional Imaging

CNS Lymphoma

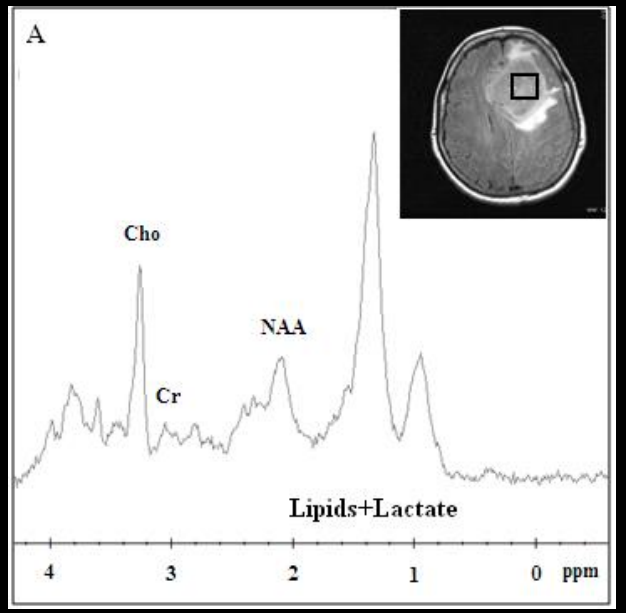
- Primary CNS Lymphoma-No systemic involvement-1% of all CNS primary malignant tumors
  - Associated with HIV/AIDS, EBV infection, post-transplantation
    - Parenchymal
    - Intravascular
    - Primary dural/leptomeningeal
  - Immunosuppression associated with necrosis, hemorrhage, and ring-like/irregular enhancement
- Secondary CNS Lymphoma
  - Parenchymal-25%
  - Leptomeningeal-75%

Secondary CNS Lymphoma

- Usually aggressive NHL
- Associated with extranodal disease and primary or acquired immunodeficiency
- Management
  - CNS:
    - Induction with high dose systemic methotrexate including intrathecal methotrexate
    - Consolidation with high dose chemotherapy with SCT or WBRT
    - Supportive care with steroids/anticonvulsants
  - Systemic: R-CHOP

Haldorsen et al, AJNR 2011; 32(6): 984-92

Secondary CNS Lymphoma- Parenchymal



- CT
  - Hyperattenuating
  - Avid enhancement
  - Hemorrhage is uncommon
- MRI
  - T1 hypointense, T2 iso-hyperintense
  - Enhancement
  - Restricted diffusion- more than high grade glioma/metastases
  - Less edema as compared to glioma and metastases
- MR spectroscopy
  - Large choline peak, high choline/creatinine ratio, elevated lipid peak
  - Markedly decreased NAA
- MR Perfusion
  - Modest, if any, increase in rCBV

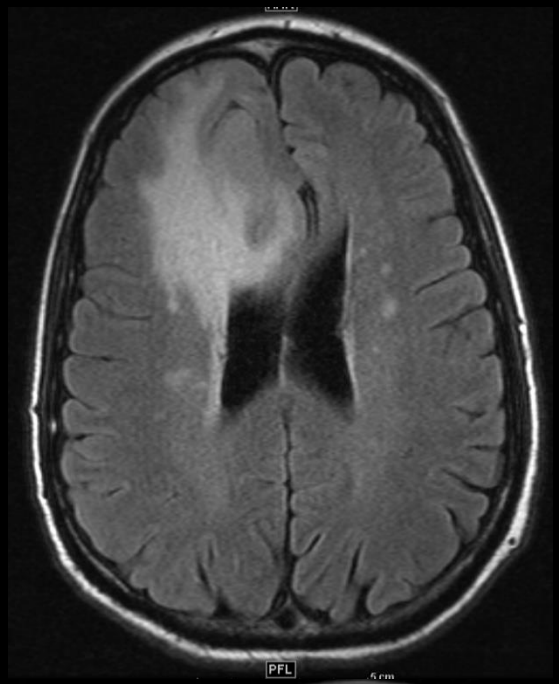
Question 1

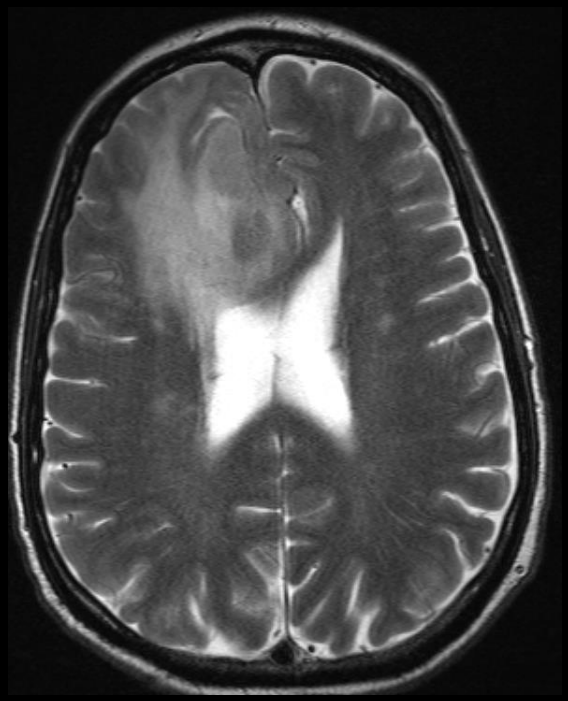
- Which of the following is an indicator of neuronal integrity on MRS?
  - Choline
  - Lactate
  - N-acetyl aspartate
  - Alanine

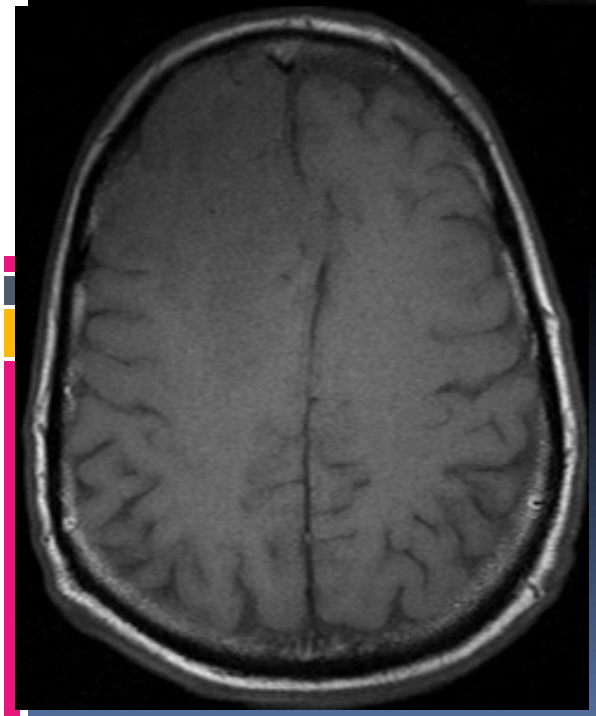
Case 2

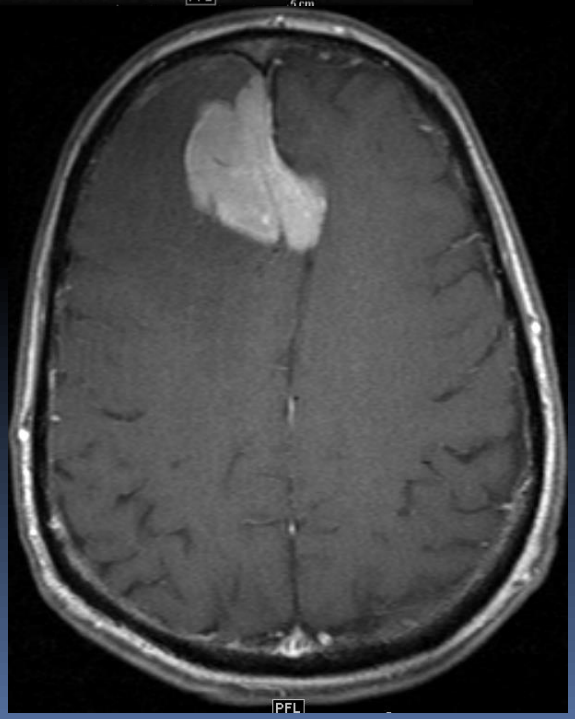
- 67 y/o with newly diagnosed lung cancer, presenting with balance issues and personality changes

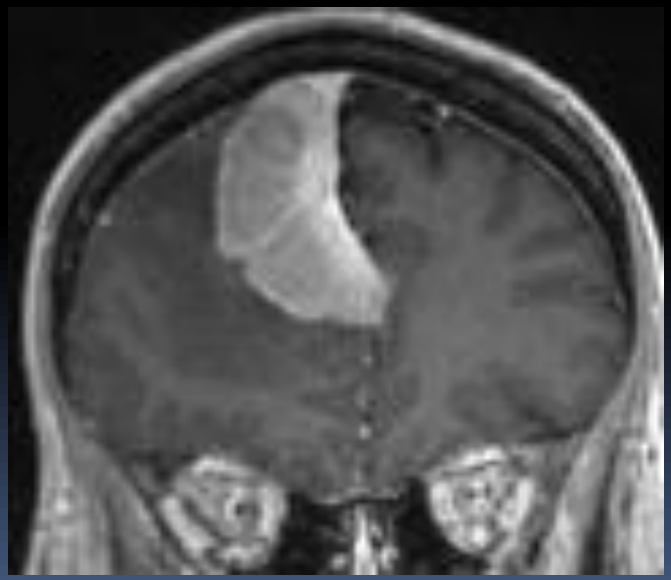
Case 2











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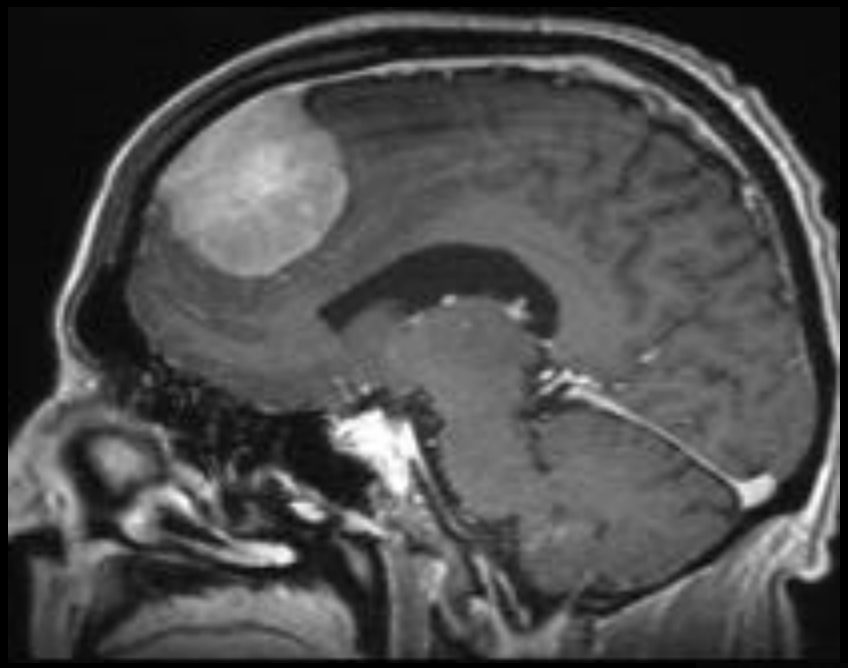
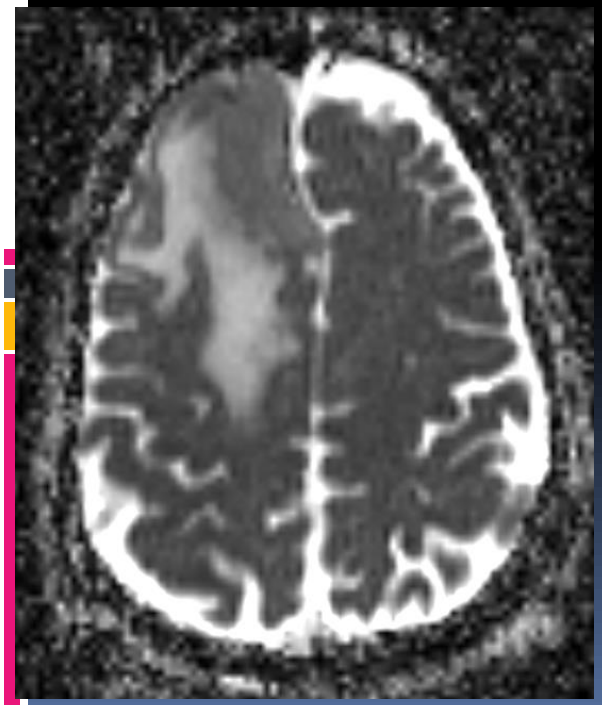
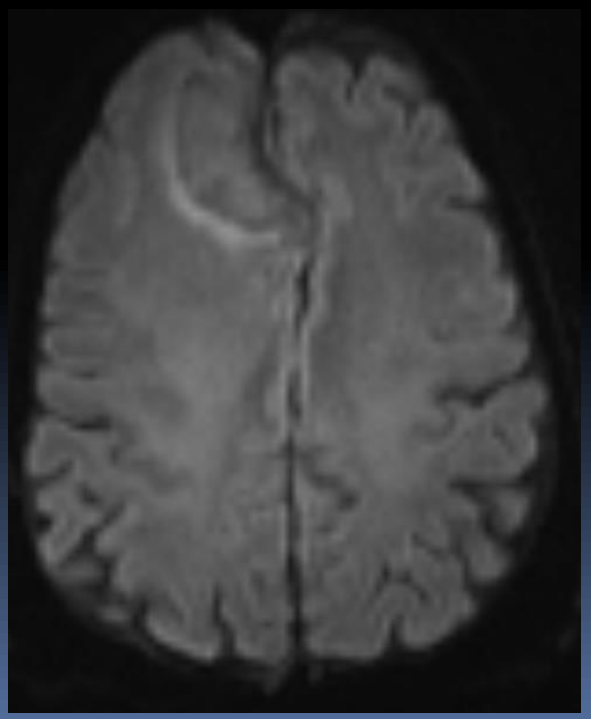
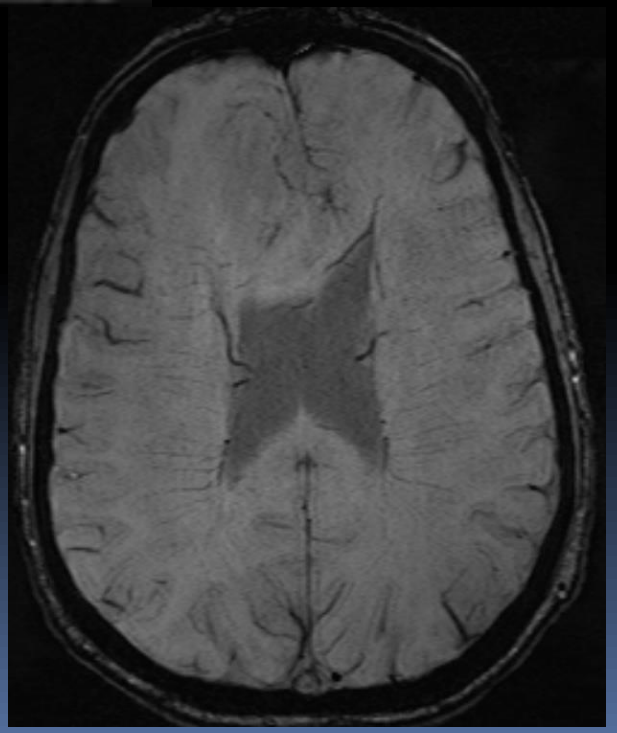


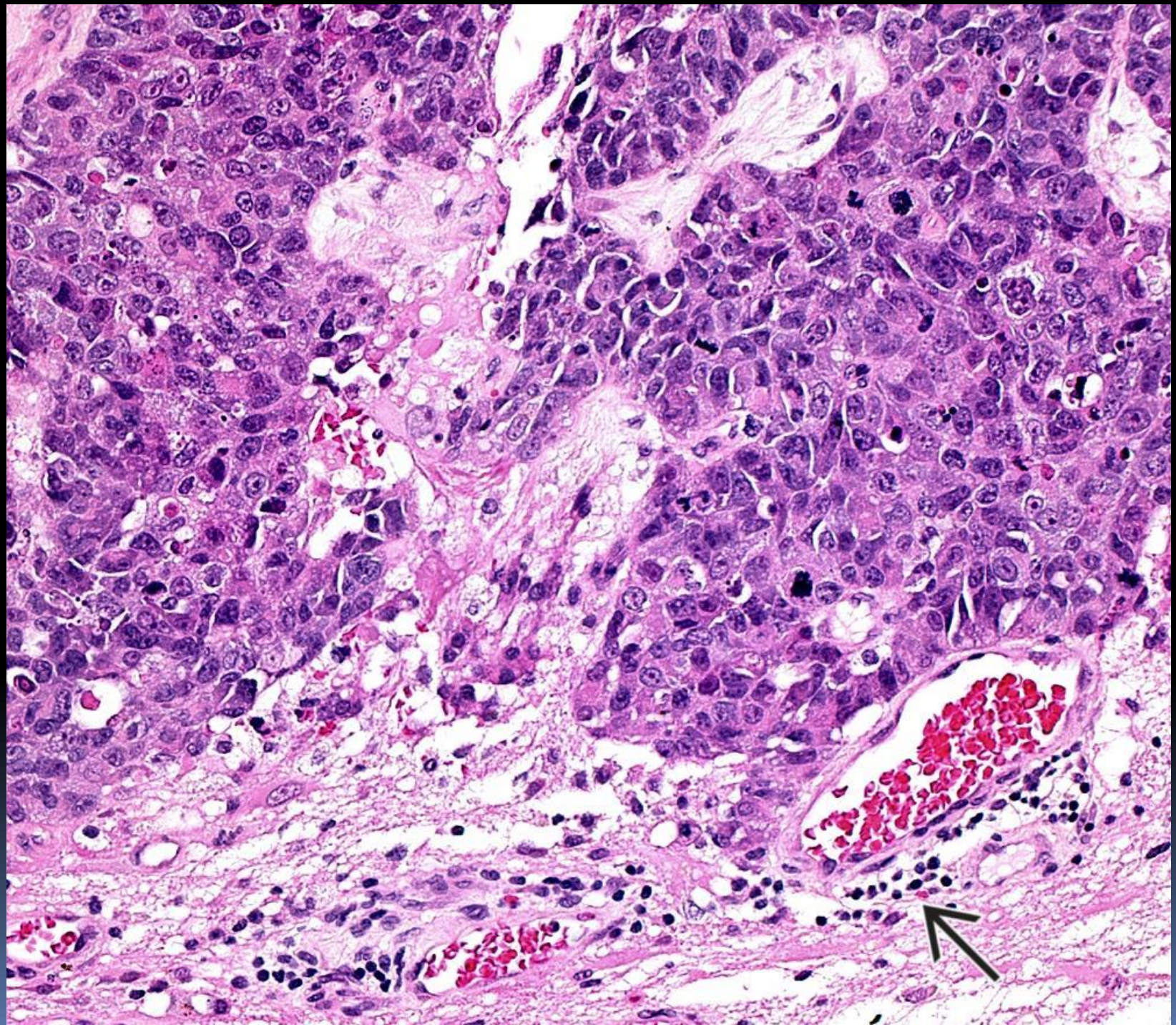






Differential Diagnosis

- Dural-based metastasis
- Aggressive meningioma
- Hemangiopericytoma



Dural metastasis

- Mechanism:
  - Hematogenous spread
  - Direct extension from skull/brain metastases
  - Surgical seeding
- Most commonly breast, prostate, lung adenoCa, RCC
- Frequently solitary
- Dural enhancement in cases of osseous metastases may represent reactive change or invasion

Boyd Smith et al, Radiographics 2014; 34:295-312

Differential Diagnosis

- Atypical/aggressive meniongiomas: Pronounced peritumoral edema
- Hemangiopericytoma
  - More aggressive with bony destruction as opposed to hyperostosis
  - Extensive peripheral vascularity and flow voids
  - Lobulated or irregular contour
  - No calcification
  - Narrow base of attachment favors HPC over meningioma
  - MRS: Myoinositol peak, no alanine peak

Boyd Smith et al, Radiographics 2014; 34:295-312

Question 2

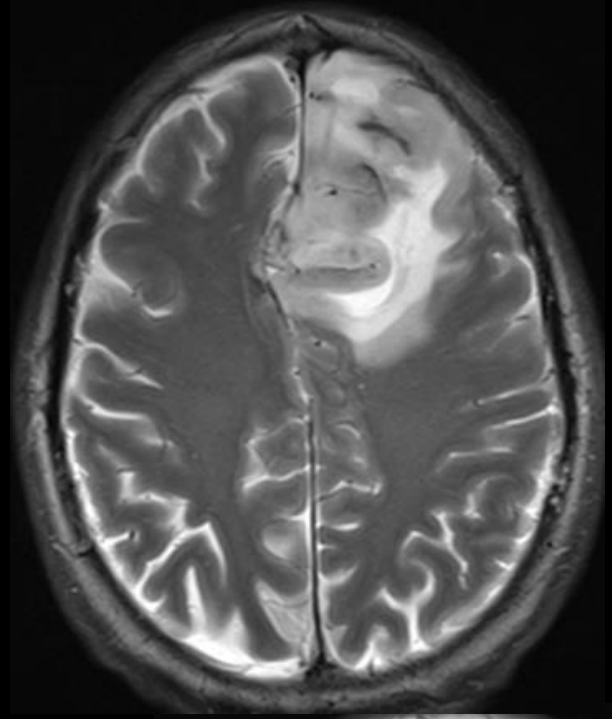
Which of the following extra-axial tumors are associated with HIV infection?

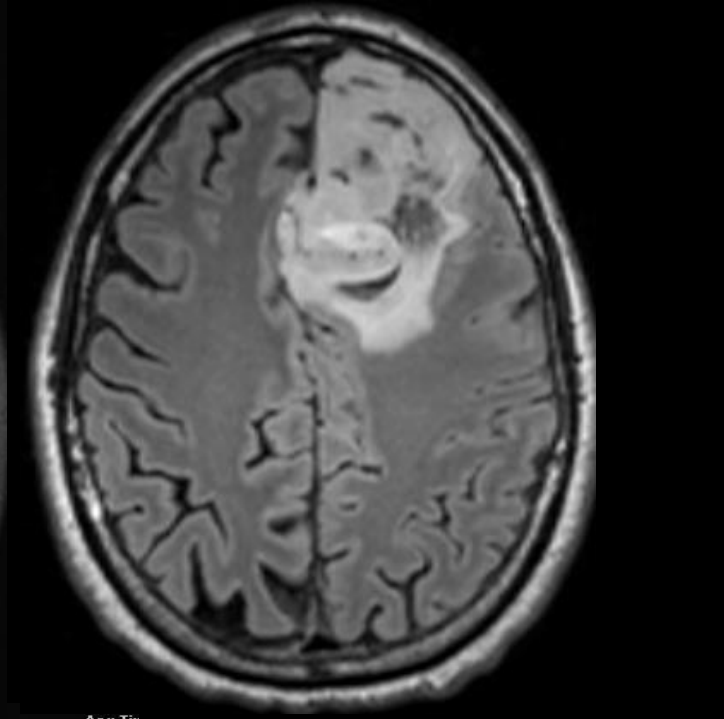
- Hemangiopericytoma
- Solitary fibrous tumor
- Leiomyosarcoma
- Meningioma

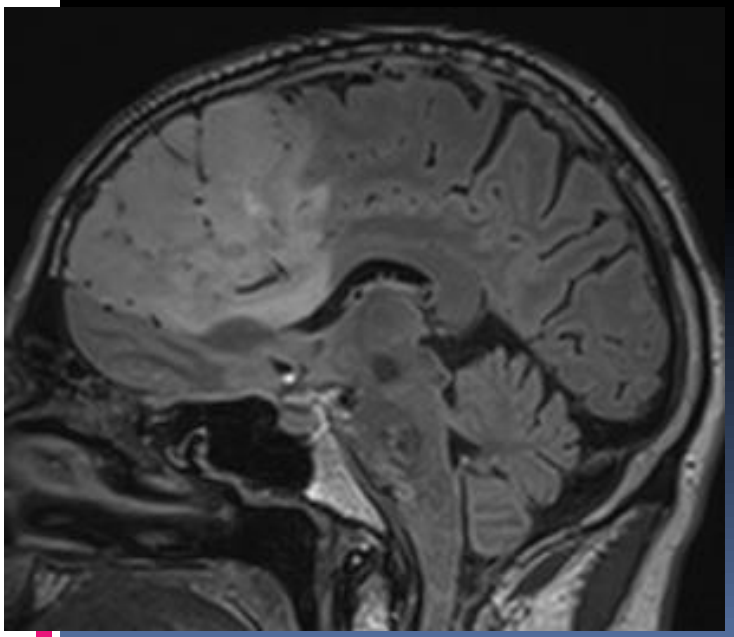
Case 3

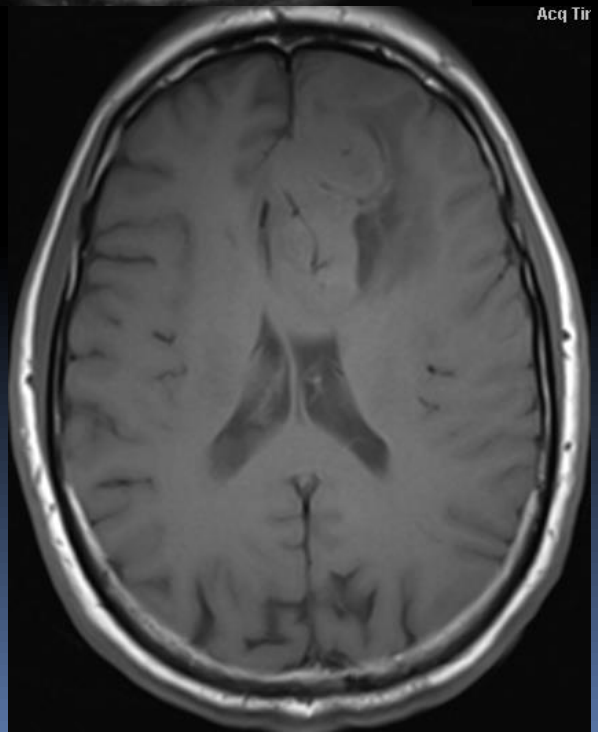
- 61 y/o male presenting with seizure

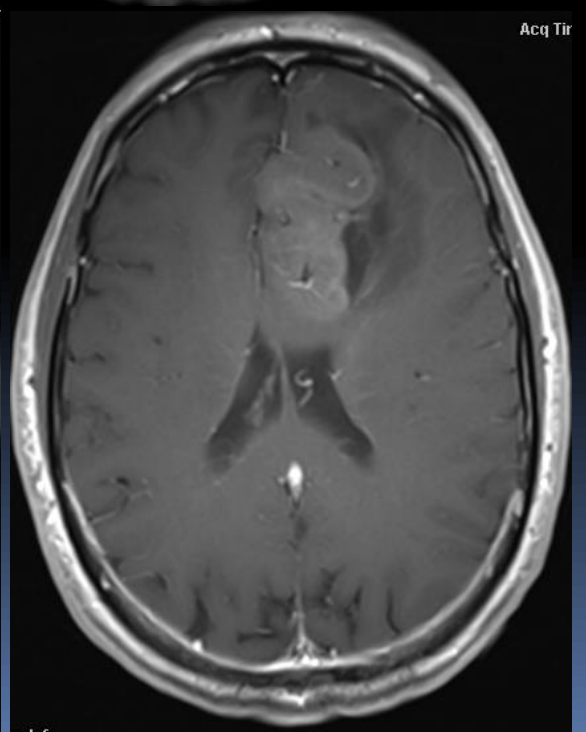
Case 3



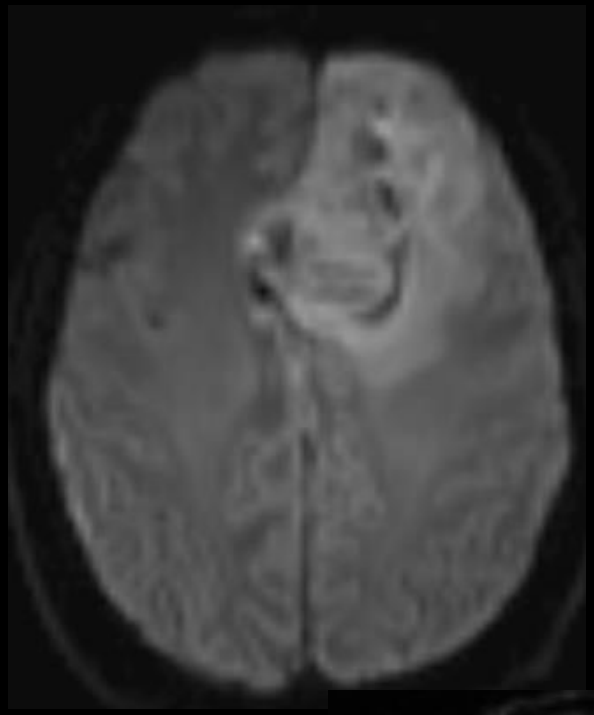


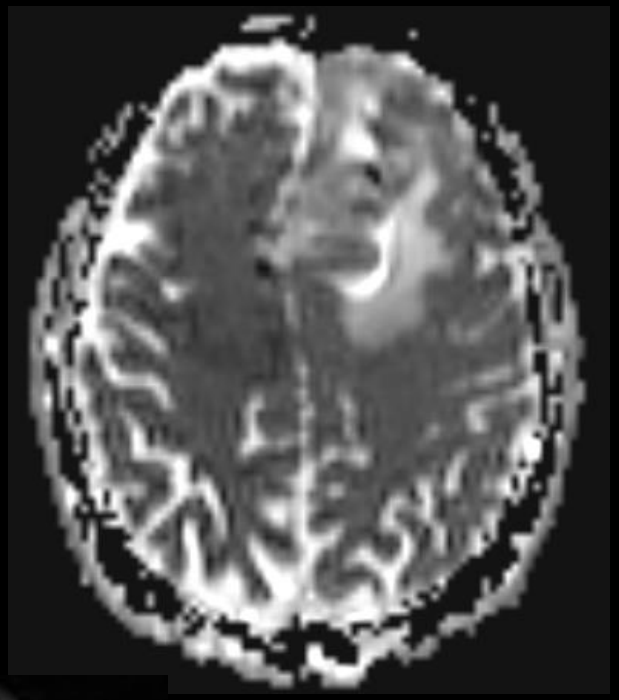


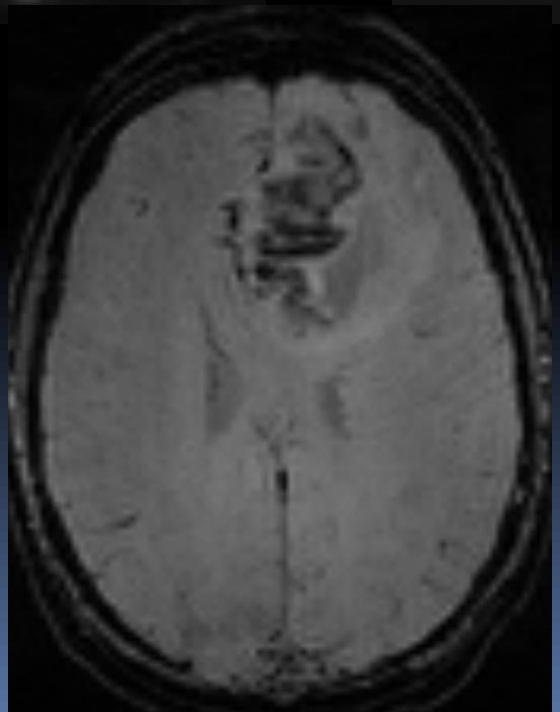




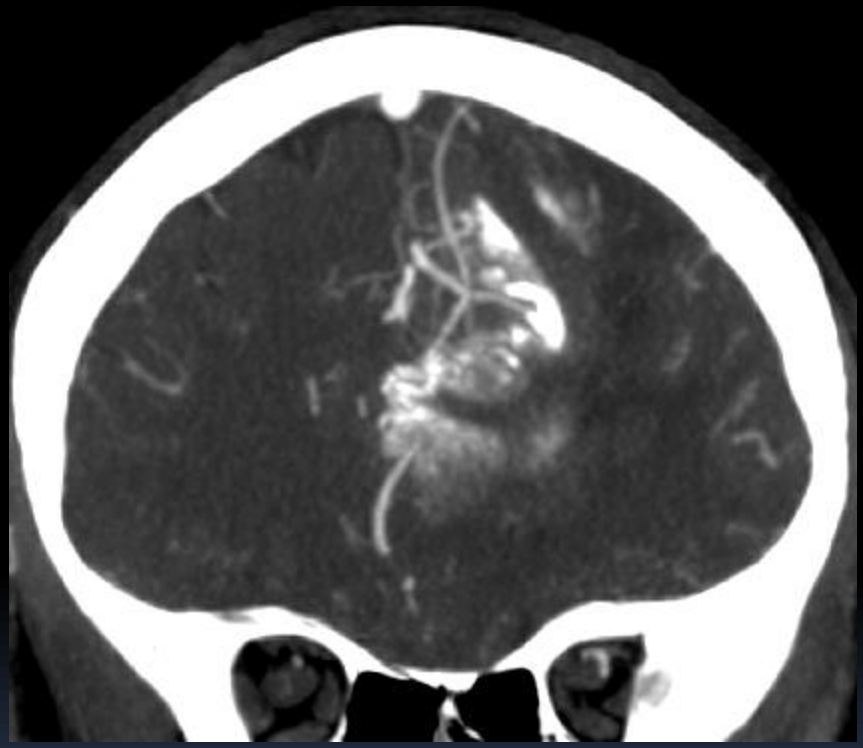
Case 3





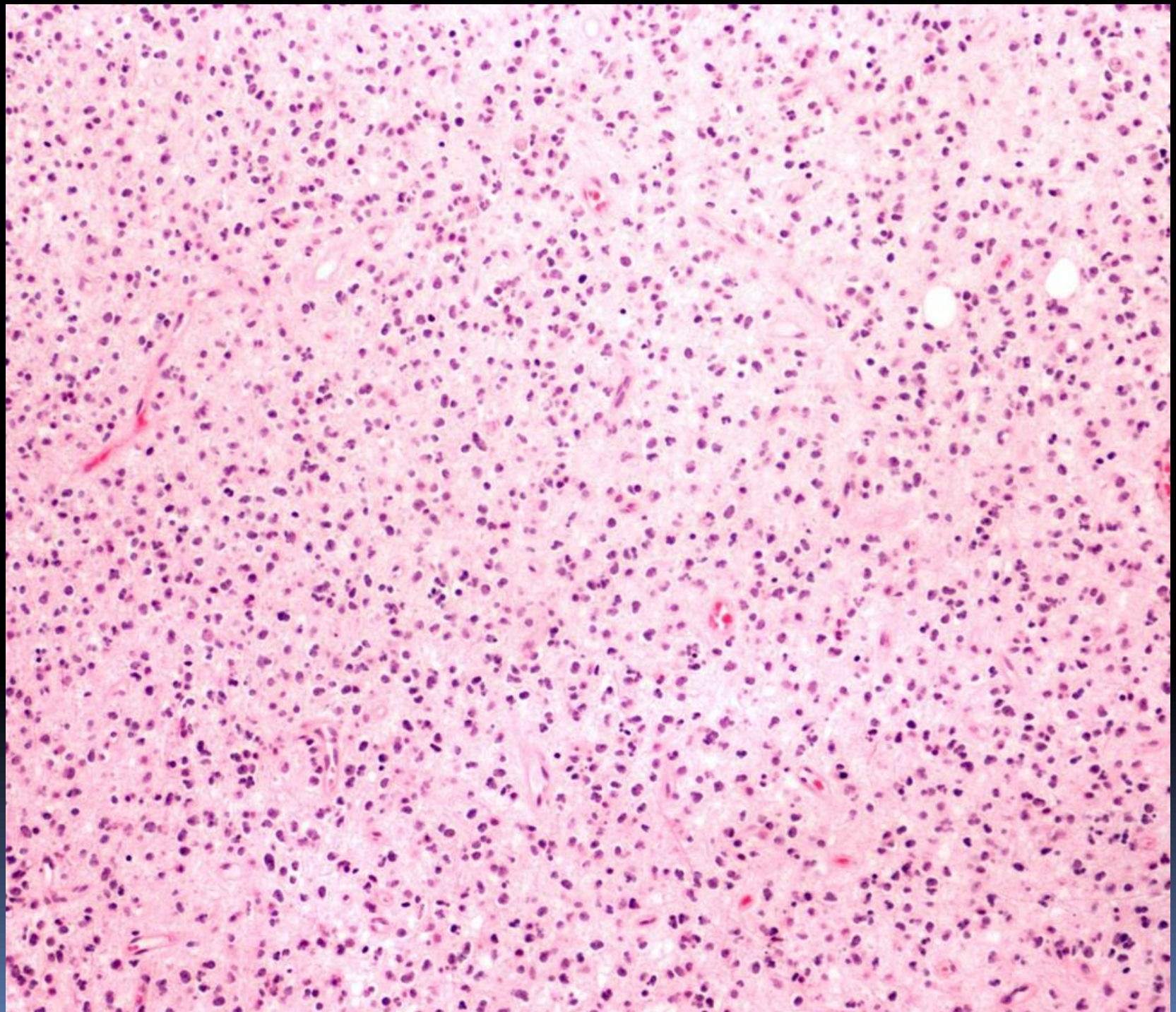


Case 3



Differential Diagnosis

- Oligodendroglioma
- Oligoastrocytoma
- Astrocytoma
- Ganglioglioma



Oligodendroglioma

- 5-25% of all gliomas
- WHO grade II-III
- Involving the cortex or subcortical white matter- most commonly the frontal lobe
- Often presents with seizures
- 70-90% are calcified- central or peripheral "ribbon-like"
- Treatment is surgery and adjuvant chemoRT
- Response is determined by 1p/19q status
- Overall 5 year survival-50-75%

Koeller et al, Radiographics 2005, 25;6:1669-88

Oligodendroglioma

- CT
  - Hypodense to isodense
  - Calcification common
  - Pressure erosion on overlying skull
- MRI
  - T1 hypointense, T2 hyperintense (except calcification)
  - Heterogenous "lacy" enhancement
  - Susceptibility artifact from calcification
  - Typically no restricted diffusion
  - Elevated rCBV

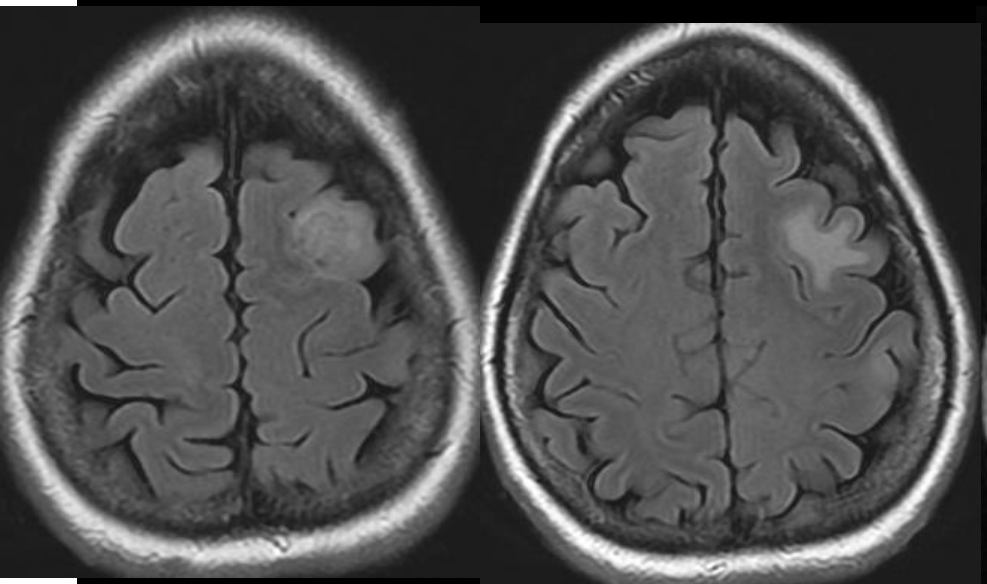
Koeller et al, Radiographics 2005, 25;6:1669-88

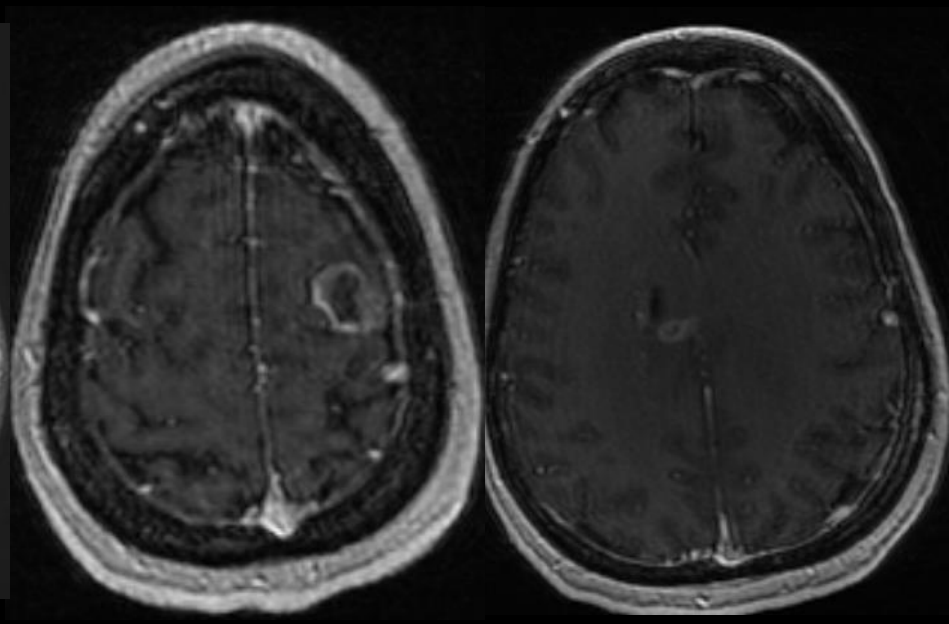
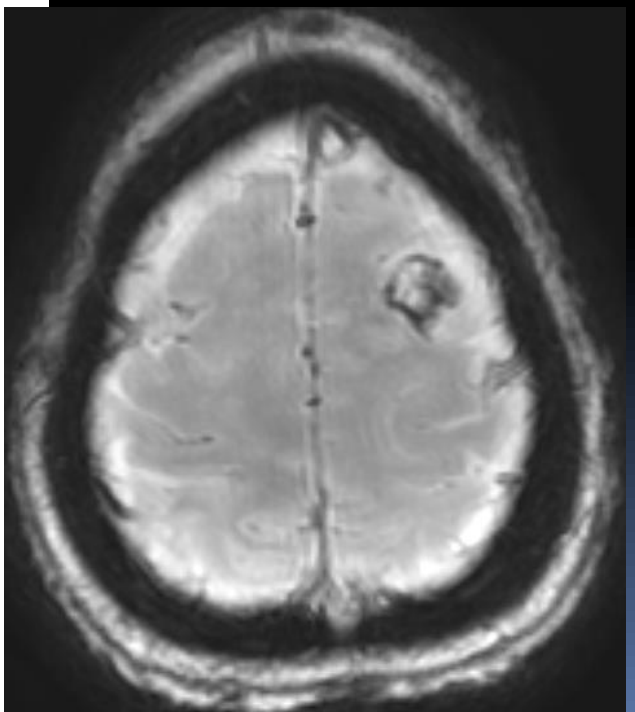
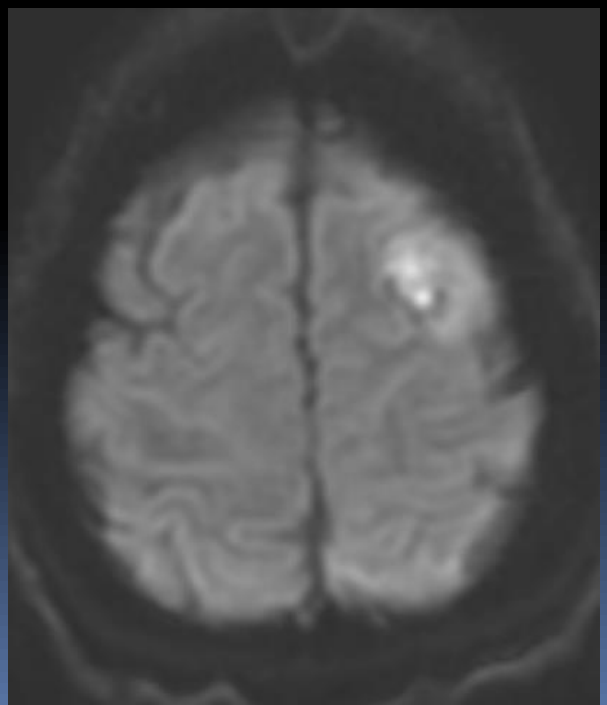
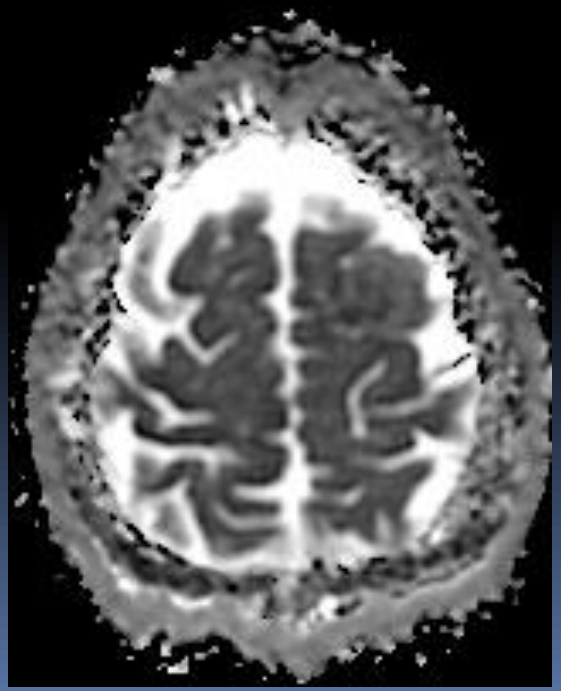
Question 3

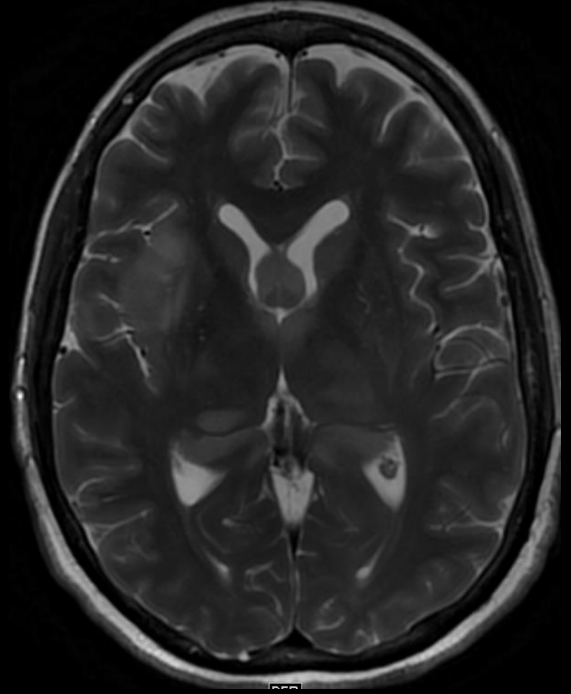
- Which of the following is FALSE regarding oligodendrogliomas with 1p/19q deletion?
  - Well-defined margins
  - Frontal lobe location more likely
  - Calcifications more likely
  - Better response to chemotherapy

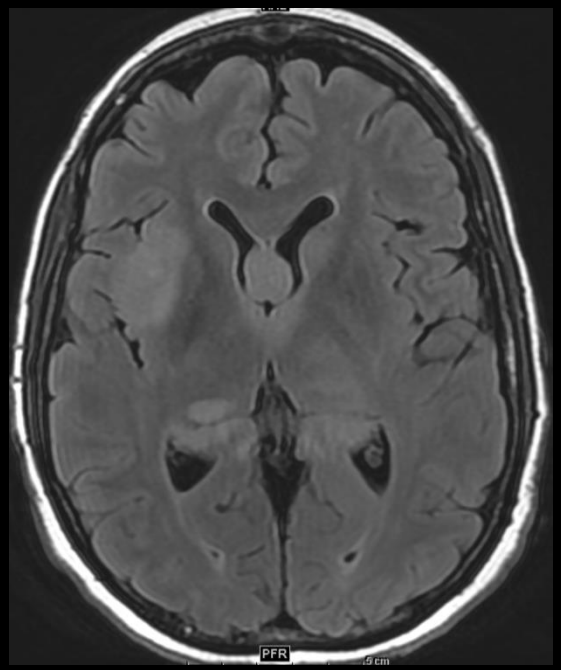
Case 4

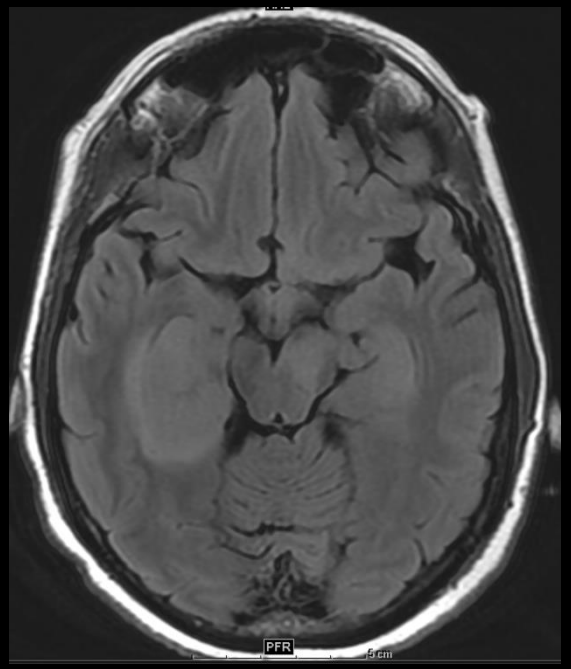
- 54 y/o female active smoker, presents with 2 weeks of confusion






PFR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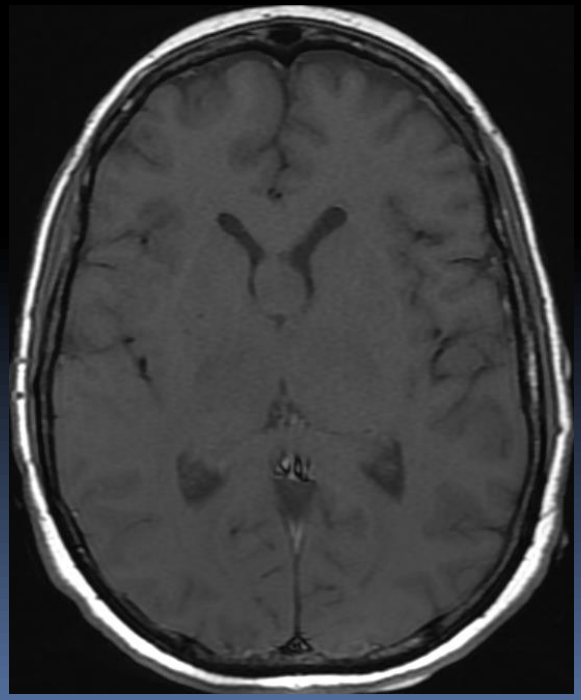
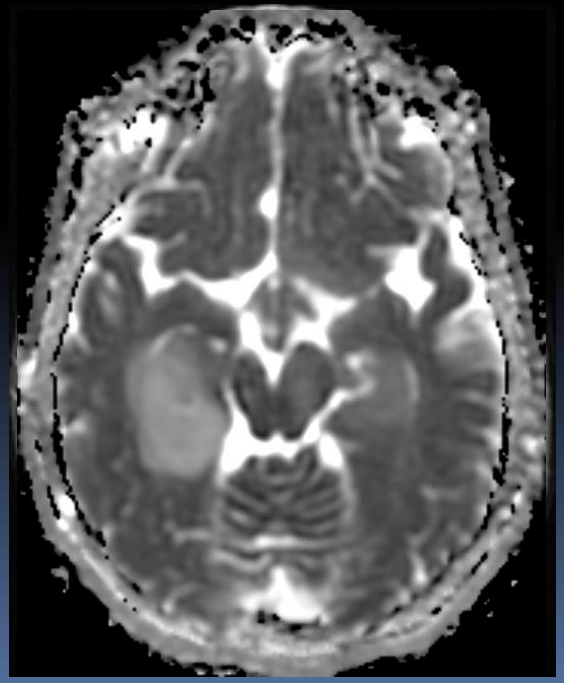
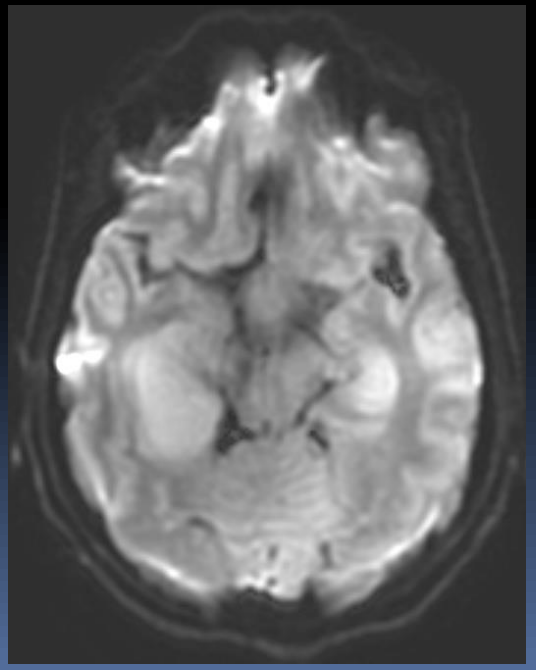
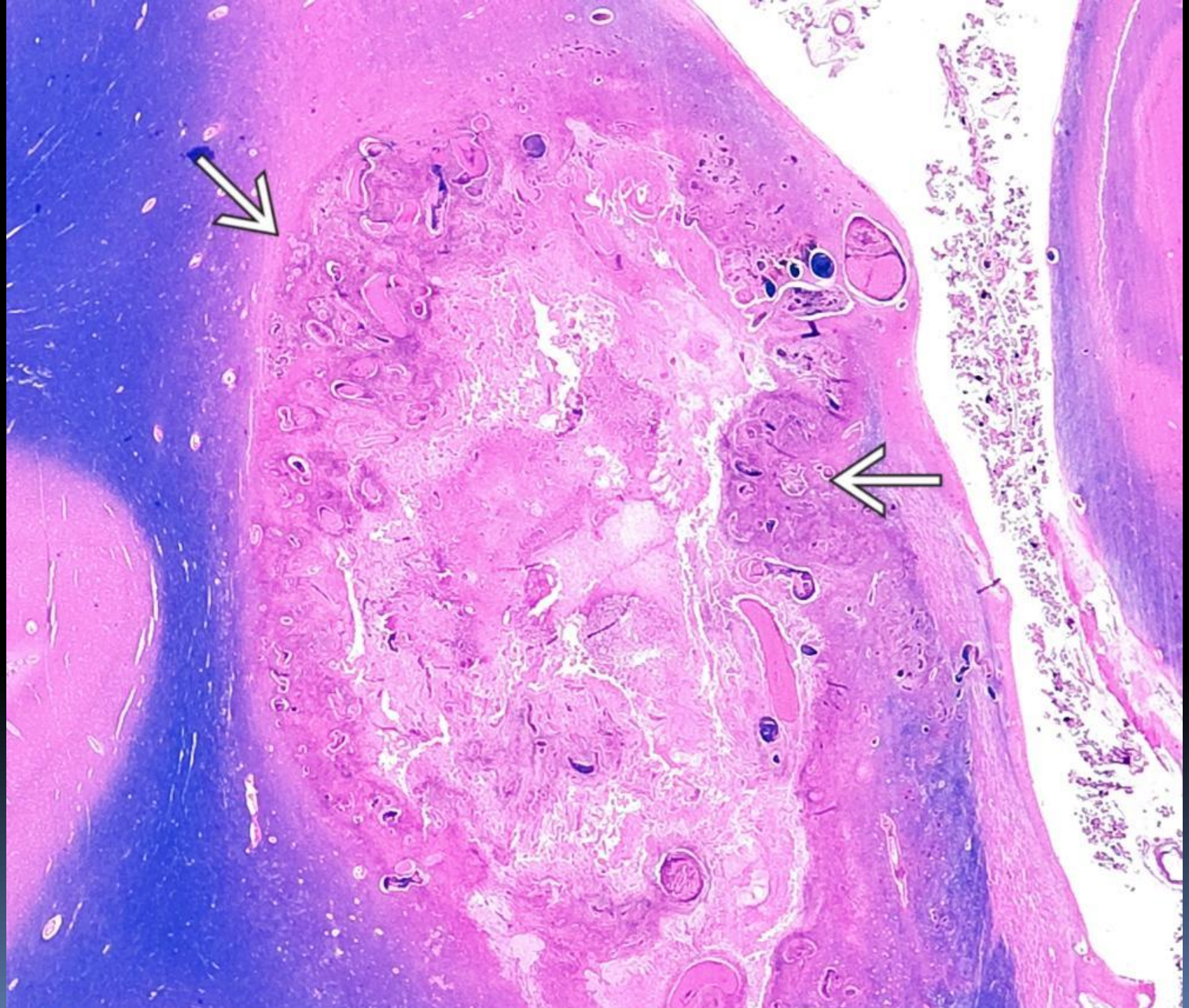






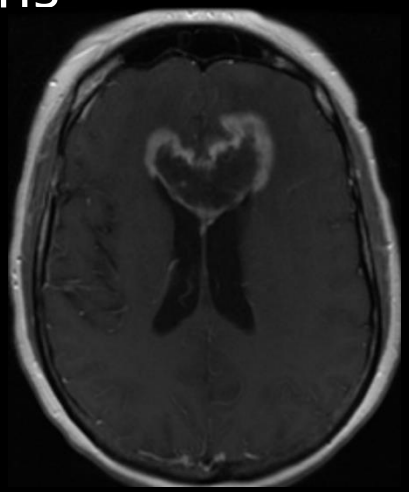
Differential Diagnosis

- GBM with gliomatosis cerebri
- Multifocal Glioma
- Lymphoma



GBM

- Most common and aggressive primary brain tumor
- WHO grade IV; median survival of 12 months
  - Primary: de novo
  - Secondary: arise from pre-existing lower grade glioma
- Multifocal in 20%, multicentric rare
- CT:
  - Irregular heterogenous mass with surrounding edema and mass effect
  - Possible internal necrosis, calcification and hemorrhage



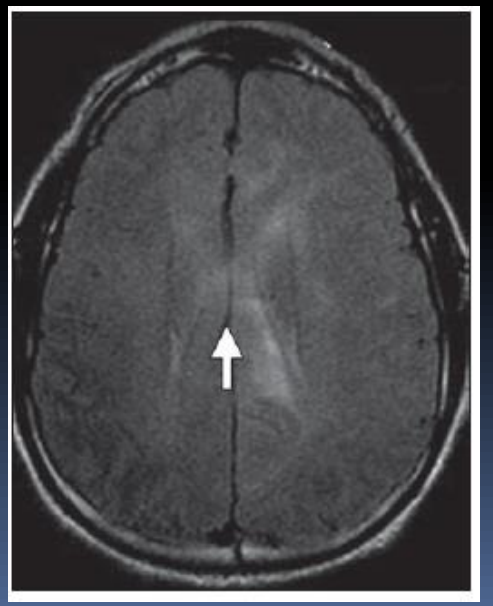
Ho et al, AJR 2013; 200: W1-w16, Yip et al, Radiographics 2003; 23:247-253

GBM

- MRI: T1 hypo/isointense, T2 hyperintense (edema and infiltration)
  - Irregular, peripheral contrast enhancement
  - Possible foci of susceptibility from hemorrhage/calcification
  - Possible incomplete hemosiderin rim inside the enhancing component
  - Possible vascular flow voids
  - Solid component: restricted diffusion
  - rCBV elevated
- MR spectroscopy
  - Choline, lactate, lipids: increased
  - NAA, myoinositol: decreased
- Treatment: Surgery, radiation, temozolamide
- MGMT methylation has better prognosis

Gliomatosis Cerebri

- Slow-growing diffuse form of glioma
- WHO grade III
- Infiltrates two or more lobes, minimal contrast enhancement, usually no restriction abnormality
- Survival of 48% at 1 year
- Type 1: no discrete mass
- Type 2: discrete mass in addition to diffuse involvement
  - Associated with IDH1 mutation



Ho et al, AJR 2013; 200: W1-w16; Yip et al, Radiographics 2003; 23:247-253

Gliomatosis Cerebri

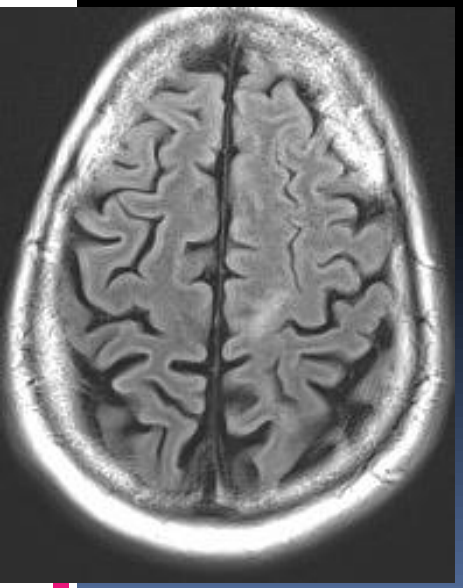
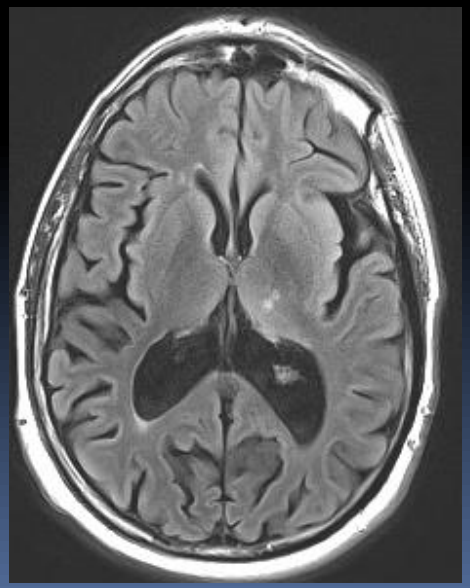
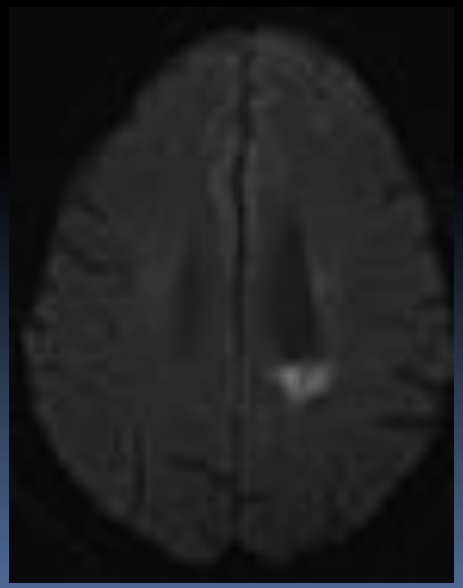
- rCBV comparable to normal white matter
- Hypometabolism on FDG-PET
- Differentiate from multifocal glioma by continuity of cellular infiltration and lack of clear distinction from adjacent parenchyma
- Chemotherapy is a treatment option; radiation has shown to improve survival but increased toxicity due to large field; surgery generally not feasible

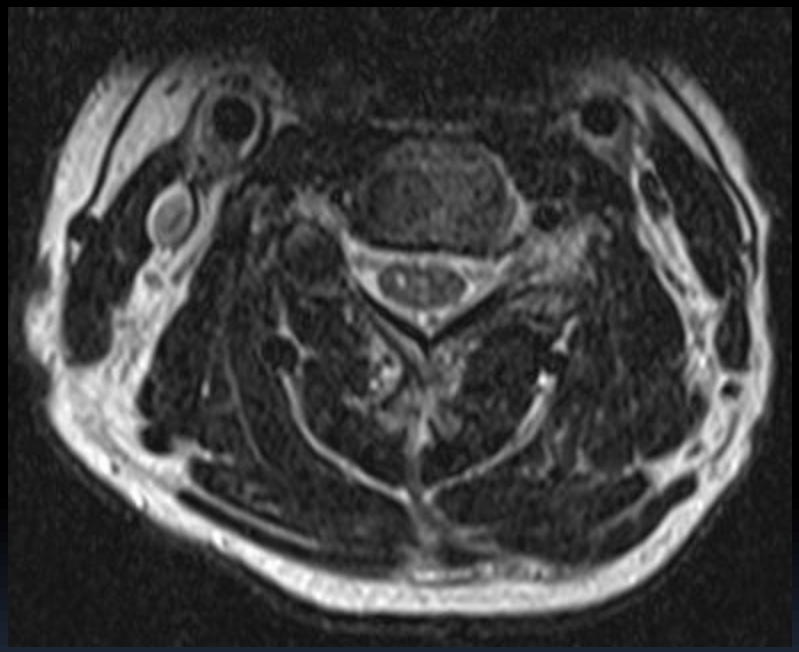
Question 4

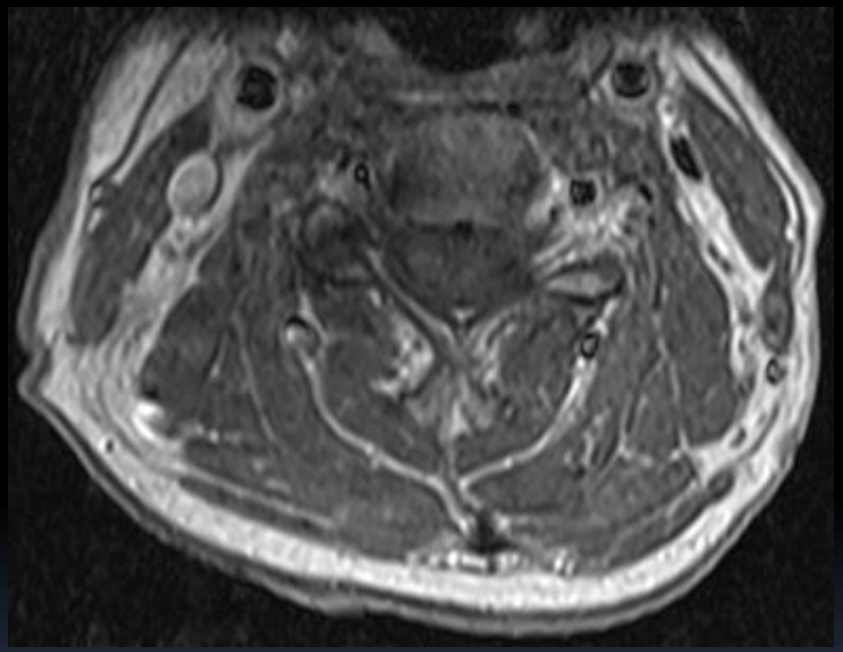
- Which of the following is NOT associated with increased risk of gliomas?
  - Li Fraumeni Syndrome
  - Neurofibromatosis 1
  - Turcot Syndrome
  - Peutz Jeghers Syndrome

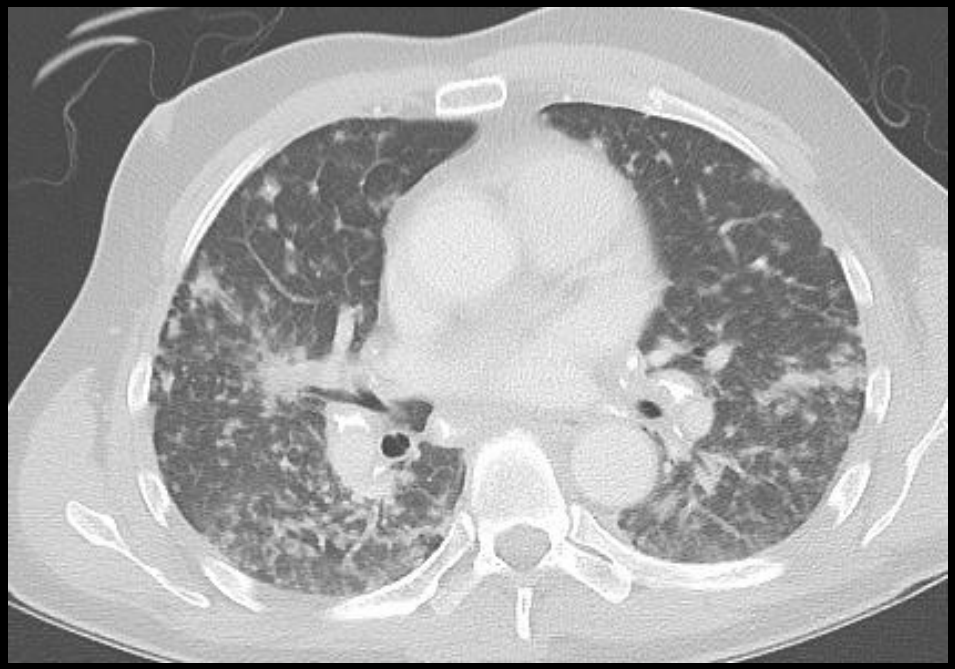
Case 5

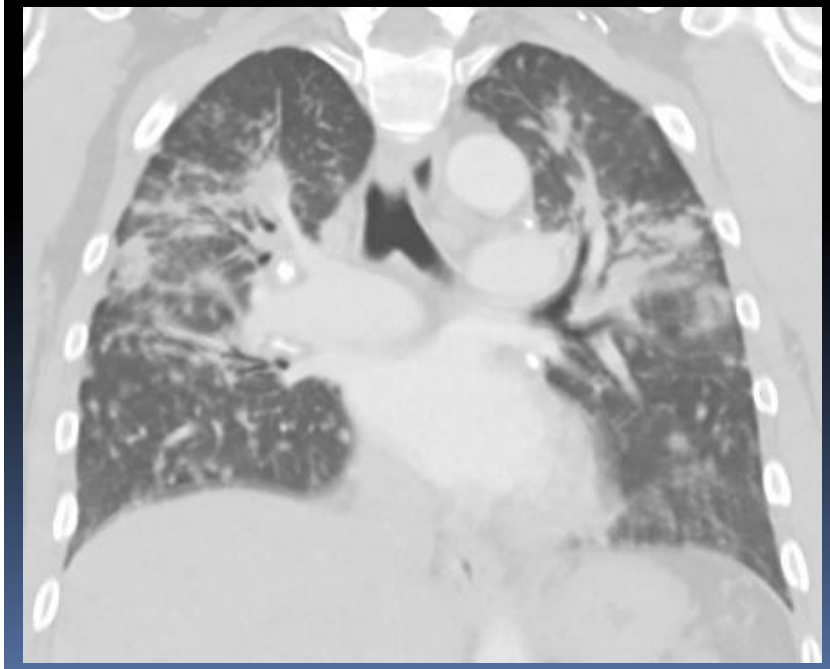
- 51 y/o male with history of cognitive delay, presented with cognitive decline, altered gait and right-sided weakness

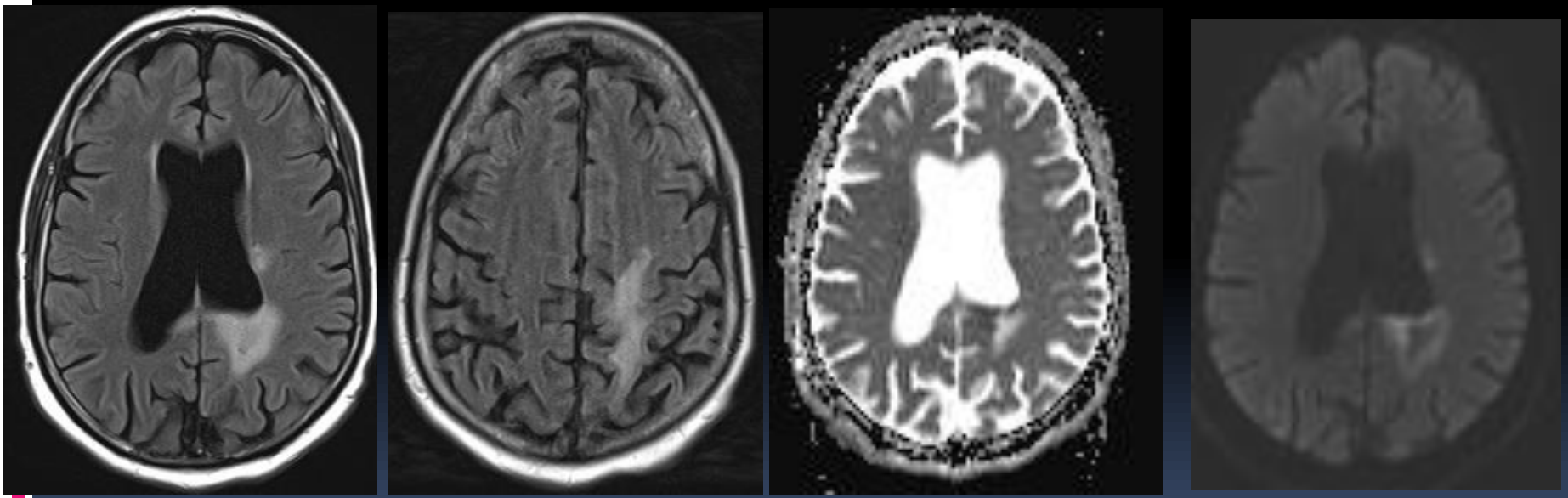







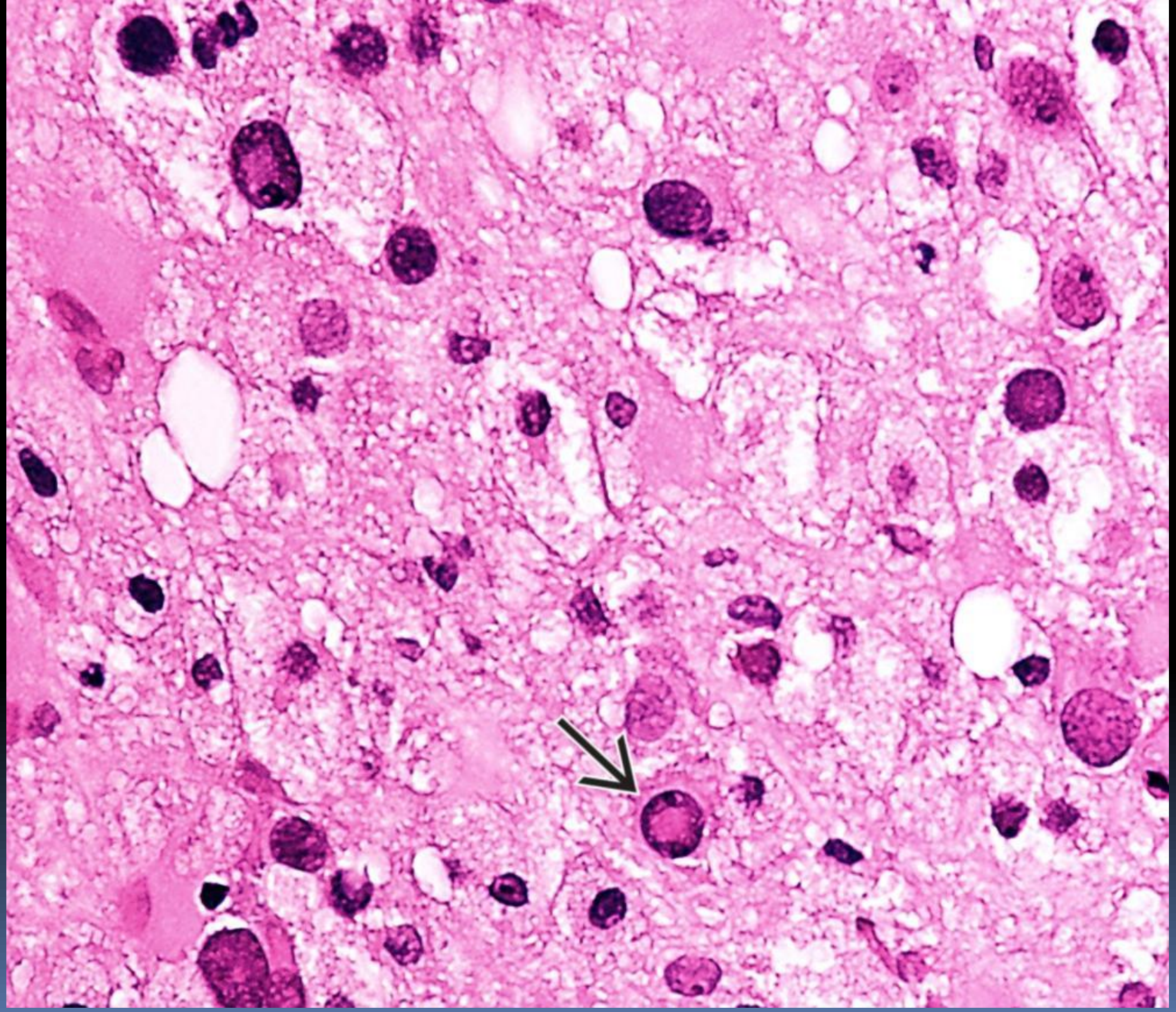


2 months later, on immunosuppression with worsening cognition and right sided weakness



Differential Diagnosis

- Demyelinating lesions
- Neurosarcoidosis
- Vasculitis



PML

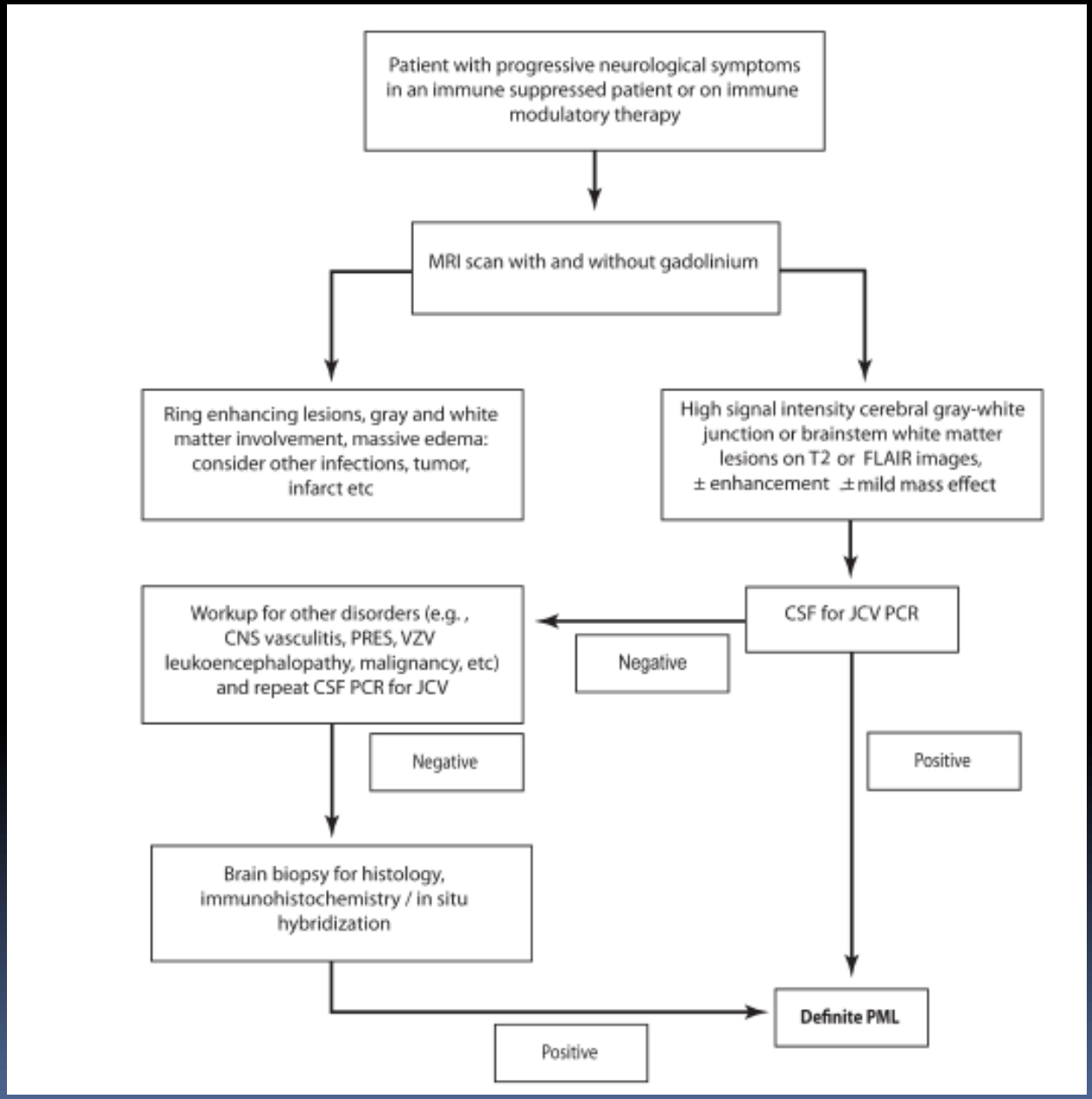
- Demyelinating disease due to reactivation of JC (John Cunningham) virus
- Most commonly associated with HIV
- Also seen in immunosuppresion (especially transplant recipients), idiopathic CD_4 lymphocytopenia
- Reported to be associated with Natalizumab treatment in Crohns disease and MS
- Diverse clinical symptoms: Cognitive and behavioural changes, motor symptoms, visual symptoms
- Lumbar puncture: CSF JCV PCR
- Biopsy: Classic triad of mutifocal demyelination, enlarged oligodendrocytes, bizarre astrocytes

Berger et al, Neurology 2013; 80: 1430-38

PML- Imaging features

- CT
  - Asymmetric areas of low attenuation in subcortical and periventricular white matter
- MRI
  - T1 iso-hypointense; T2-hyperintense
  - No or faint peripheral enhancement
  - Involves subcortical U fibers, periventricular white matter
  - Some reports of enhancement associated with better prognosis
  - Some reports of leading edge of restricted diffusivity

B Smith et al, Radiographics 2008; 28:2033-2058


Patient with progressive neurological symptoms in an immune suppressed patient or on immune modulatory therapy
MRI scan with and without gadolinium
Ring enhancing lesions, gray and white matter involvement, massive edema: consider other infections, tumor, infarct etc
High signal intensity cerebral gray-white junction or brainstem white matter lesions on T2 or FLAIR images, ± enhancement ± mild mass effect
CSF for JCV PCR
Negative
Workup for other disorders (e.g., CNS vasculitis, PRES, VZV leukoencephalopathy, malignancy, etc) and repeat CSF PCR for JCV
Positive
Negative
Brain biopsy for histology, immunohistochemistry / in situ hybridization
Definite PML
Positive

PML and Sarcoidosis

- Case series of 30 cases of sarcoidosis and PML (HIV negative)
- 10/30: No sarcoid treatment prior to PML
- 7/30: PML disclosed occult sarcoid
- 19/30: Misdiagnosed as neurosarcoidosis
- Delay in diagnosis by 4.5 ± 3.9 months with worsening symptoms during the delay
- Mean CD_4 count: 235.2 ± 142
- Treatment: Immunosuppression reversal, trial of IL-2, antiviral agents such as cidofovir, mefloquine, and mirtazapine

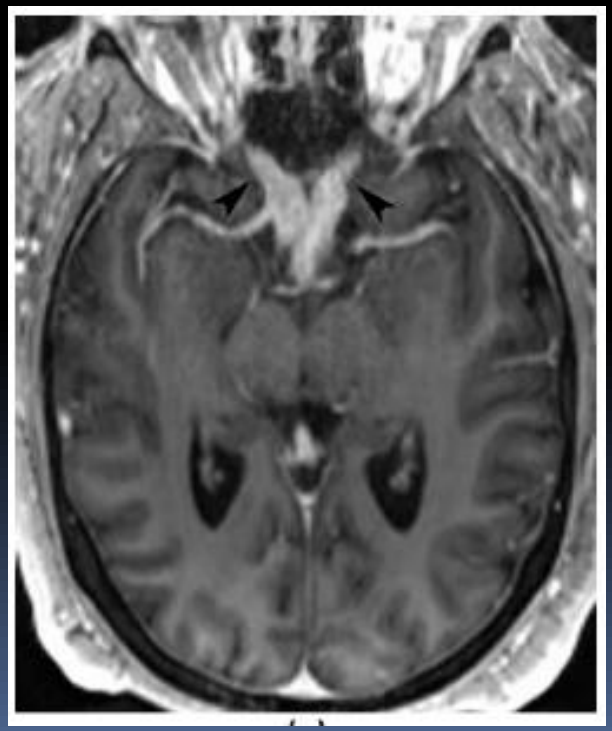
Neurosarcoidosis

- Clinically in 5% and on imaging in 10% of sarcoidosis patients
- Most frequently present with cranial nerve dysfunction or aseptic meningitis
- CNS involvement thought to be secondary to spread from leptomeninges along the Virchow-Robin spaces
- Peri-ventricular and white matter T2 hyperintensity
- Parenchymal granulomas: isointense on T1, hyperintense on T2 (hemorrhage may change appearance), diffuse or rim enhancement, necrosis and calcification rare
- Leptomeningeal involvement-40%
- Hypothalamic-pituitary axis involvement in 18%
- Small vessel vasculitis and stroke-rare

Bathla et al, Clinical Radiology 2016; 71:96-106

Question 5

- Which cranial nerve is most commonly involved by neurosarcoidosis on imaging?
  - Optic
  - Trigeminal
  - Facial
  - Vestibulocochlear



Bathla et al, Clinical Radiology 2016; 71:96-106

Acknowledgements

- Angela Giardino
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- John Kim
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- Shanna Matalon

Additional References

- Radiopedia
- ACR Appropriateness Criteria
- Uptodate