

Primary CNS Lymphoma in Immunocompetent and Immunocompromised Patients

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Objectives

- Learn the differential diagnosis of brain masses
- Understand the common imaging features of primary CNS lymphoma on both CT and MRI
- Learn the differences in imaging features of primary CNS lymphoma between immunocompetent and immunocompromised patients
- Understand the role of imaging in primary CNS lymphoma

- *We will be doing all of this with the aid of patient cases*

Our patient, AG

- 81 year old female who presented to BIDMC ED with a one-month history of word-finding difficulty and a one-week history of seizure activity

Neuroradiographic Imaging

Used for detection of lesions, localization, determining extent of disease and characterization

- CT
 - MRI
-
- Contrast enhancement increases the sensitivity of both modalities for the detection of brain tumors

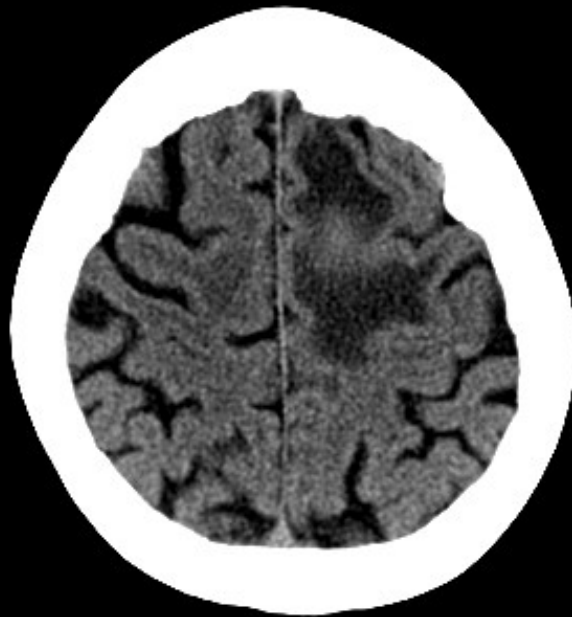
Neuro CT

- Utilized for evaluating acute brain hemorrhage
 - speed
 - high sensitivity in detection
 - wide-spread availability
- Better than MRI at detecting calcifications - evaluating for cerebrovascular disease
- Indications:
 - sudden-onset neurologic symptoms
 - if patient has contraindications for MRI (ferromagnetic implants, unstable)
 - often performed if patient presents to ED

Neuro MRI

- Most sensitive for neurologic lesion detection
 - Superior tissue resolution
- Multiplanar capability - determination of tumor site of origin

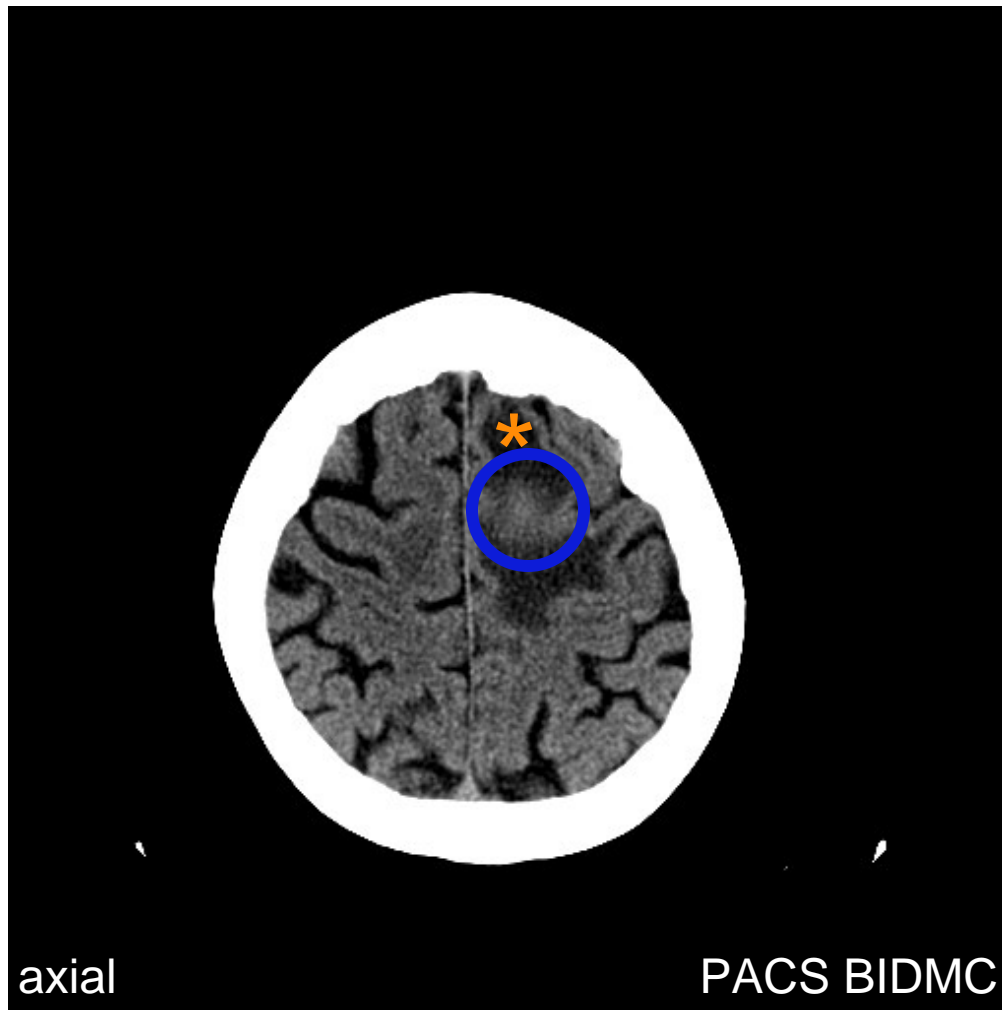
AG: Non-contrast Head CT



axial

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AG: Non-contrast Head CT with highlighted findings



- L frontal lobe mass lesion
- Iso- to hyperdense compared to surrounding gray matter
- Surrounding vasogenic edema
- No evidence of hemorrhage (would show high attenuation)

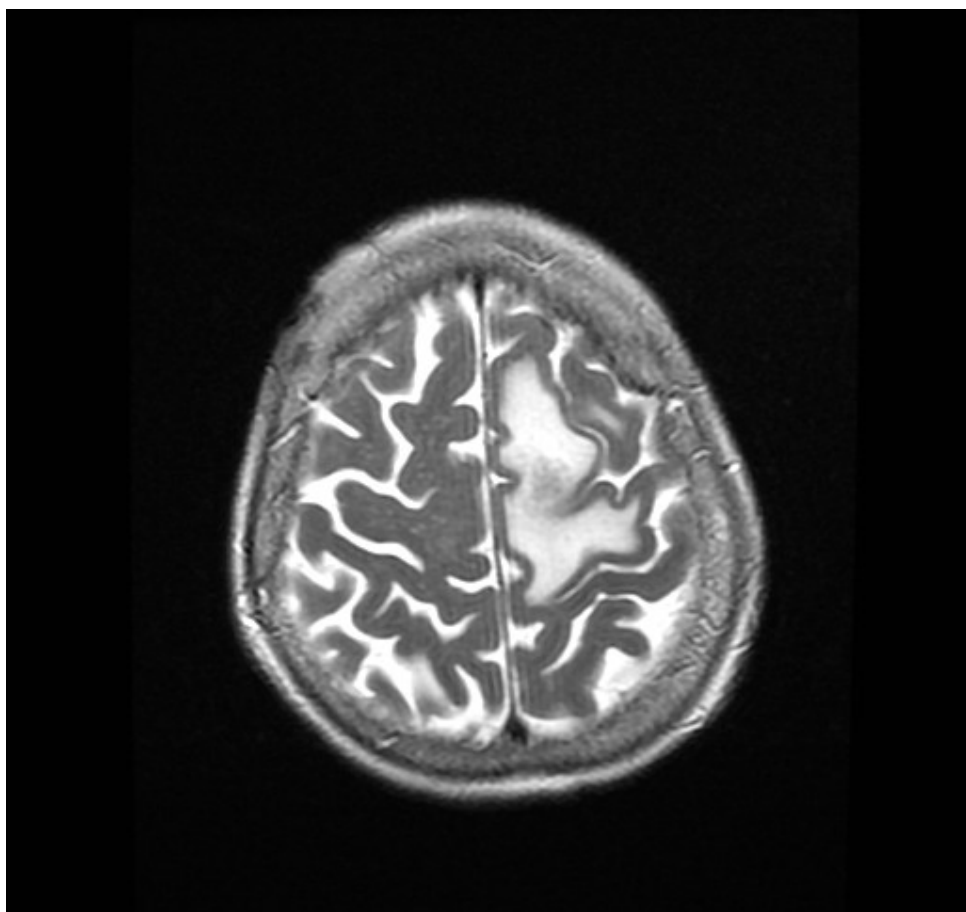
Differential diagnosis for intracranial mass

- Primary brain tumor
 - Glioma, lymphoma, meningioma
- Metastatic brain tumor
- Infection
 - Abscess, toxoplasmosis
- Inflammatory
 - Multiple sclerosis, post-infectious encephalomyelitis
- Vascular
 - Hemorrhage
 - Infarction

- How can we further characterize this lesion and narrow our differential?

- MRI

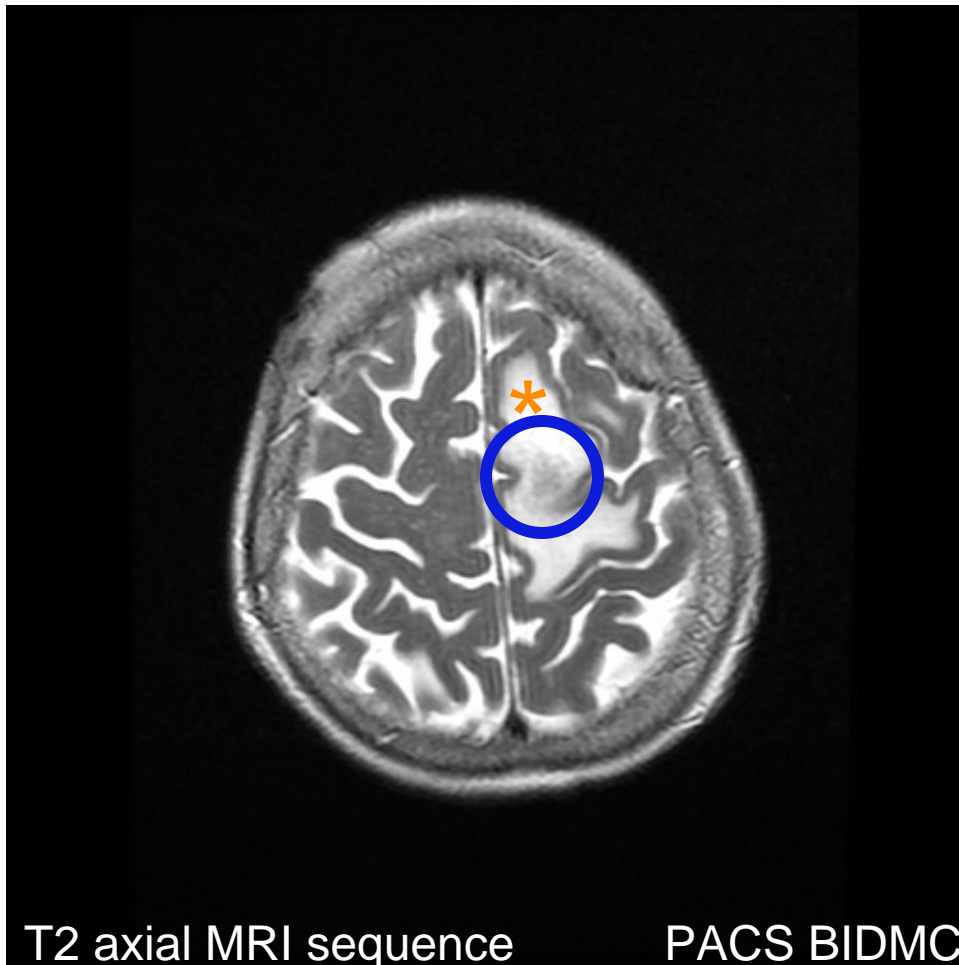
AG: Head MRI, image 1



T2 axial MRI sequence

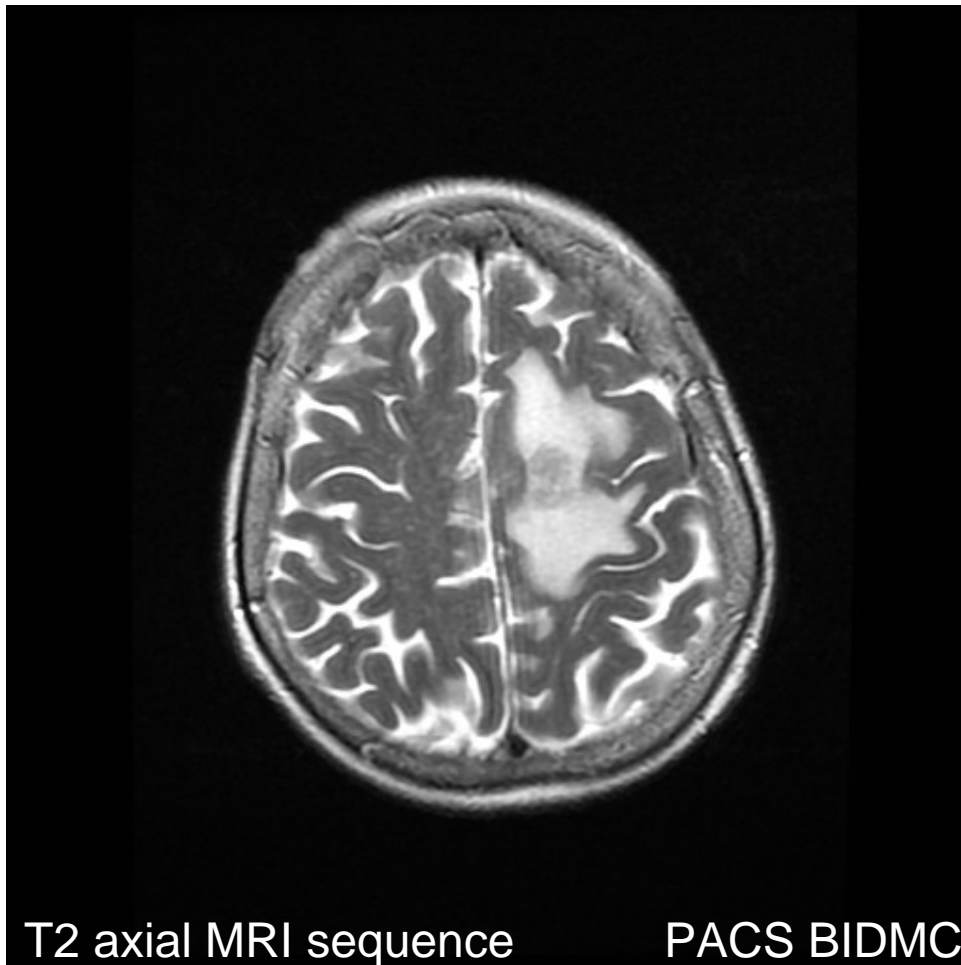
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AG: Head MRI, image 1 with highlighted findings

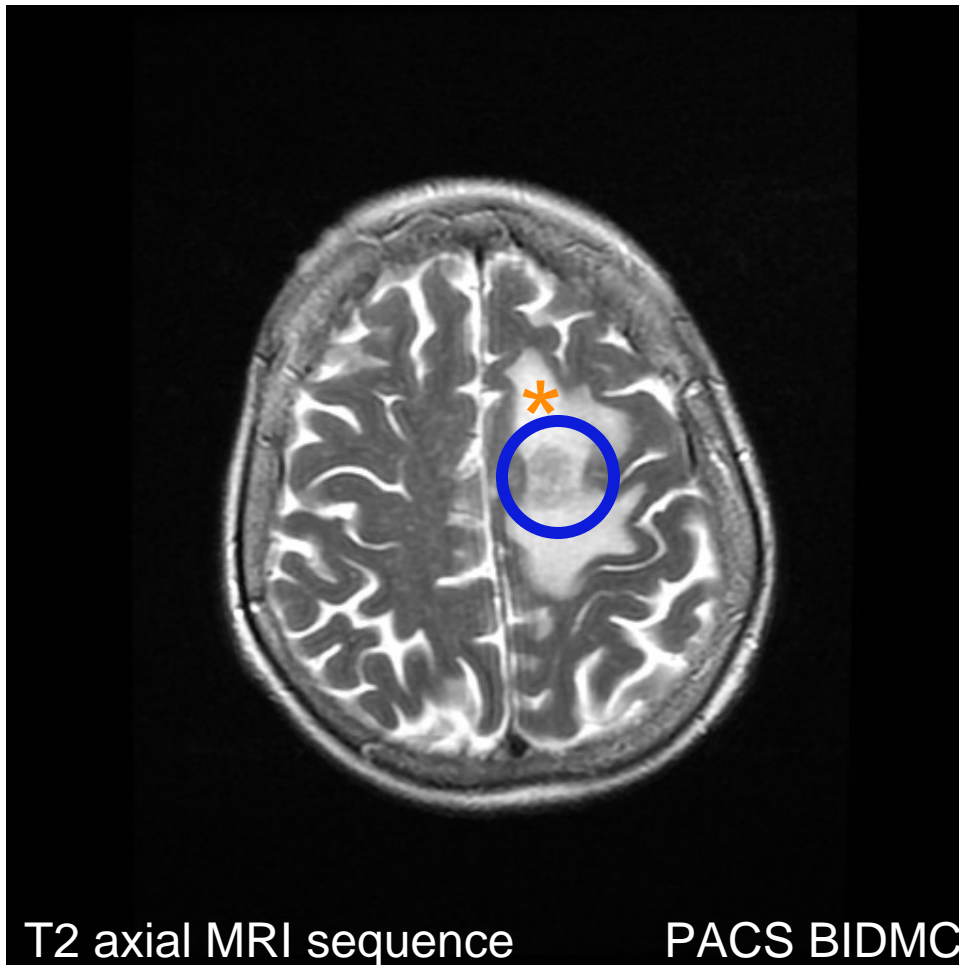


- Homogeneous, hypointense mass
- Surrounding vasogenic edema

AG: Head MRI, image 2



AG: Head MRI, image 2 with highlighted findings

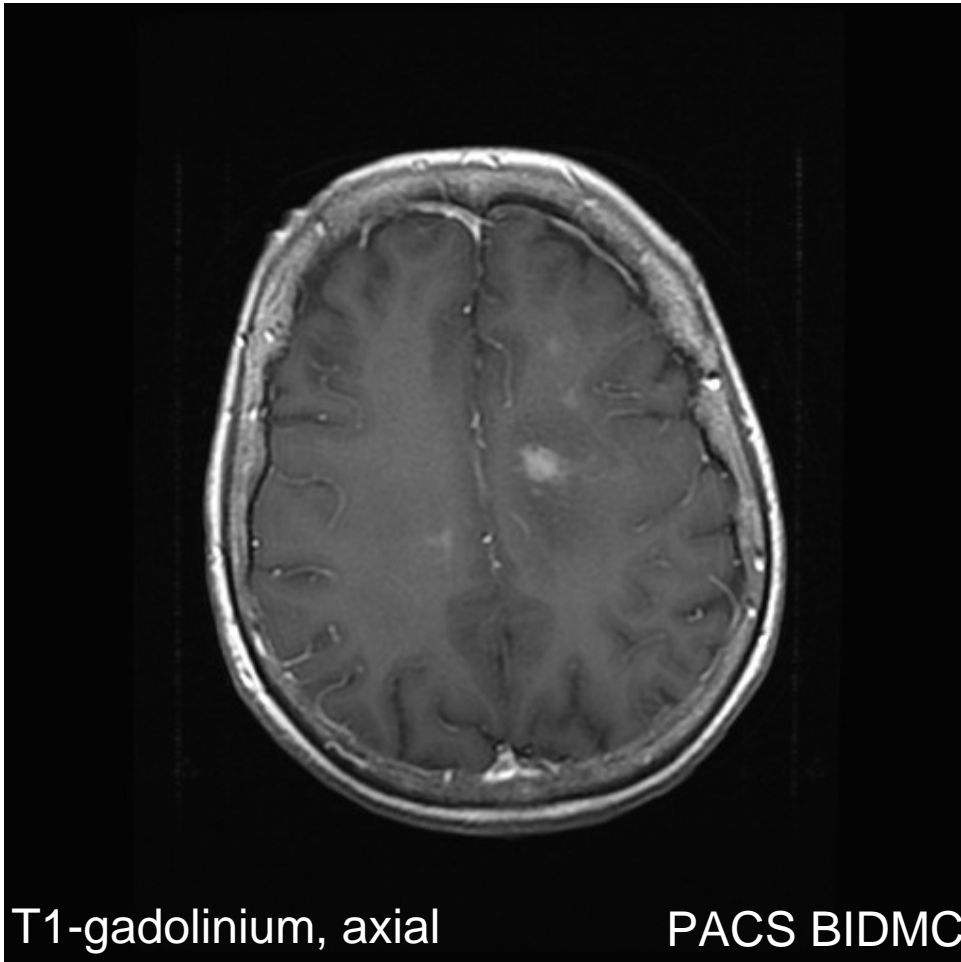


- Homogeneous, hypointense mass
- Surrounding vasogenic edema

AG: Head MRI findings from T2 sequences

- Homogeneous, hypointense mass involving left cerebral hemisphere (frontal lobe)
- Surrounding vasogenic edema

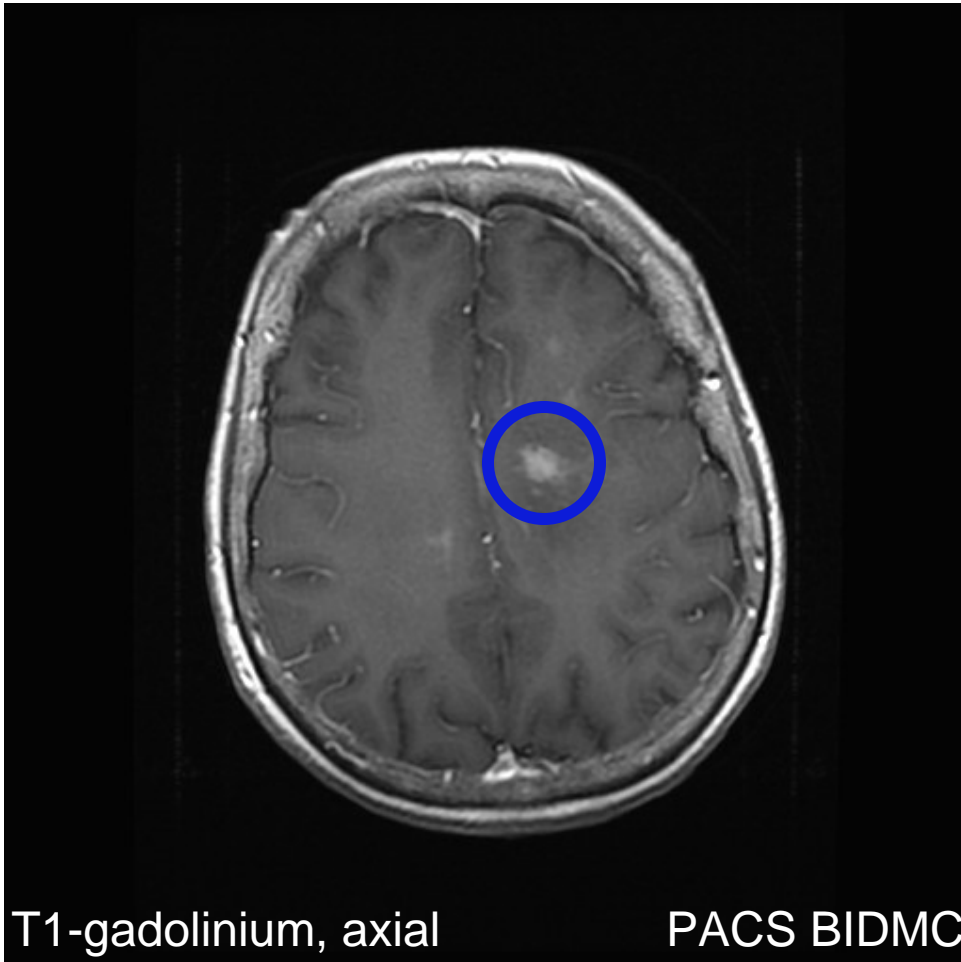
AG: contrast-enhanced MRI, image 1



T1-gadolinium, axial

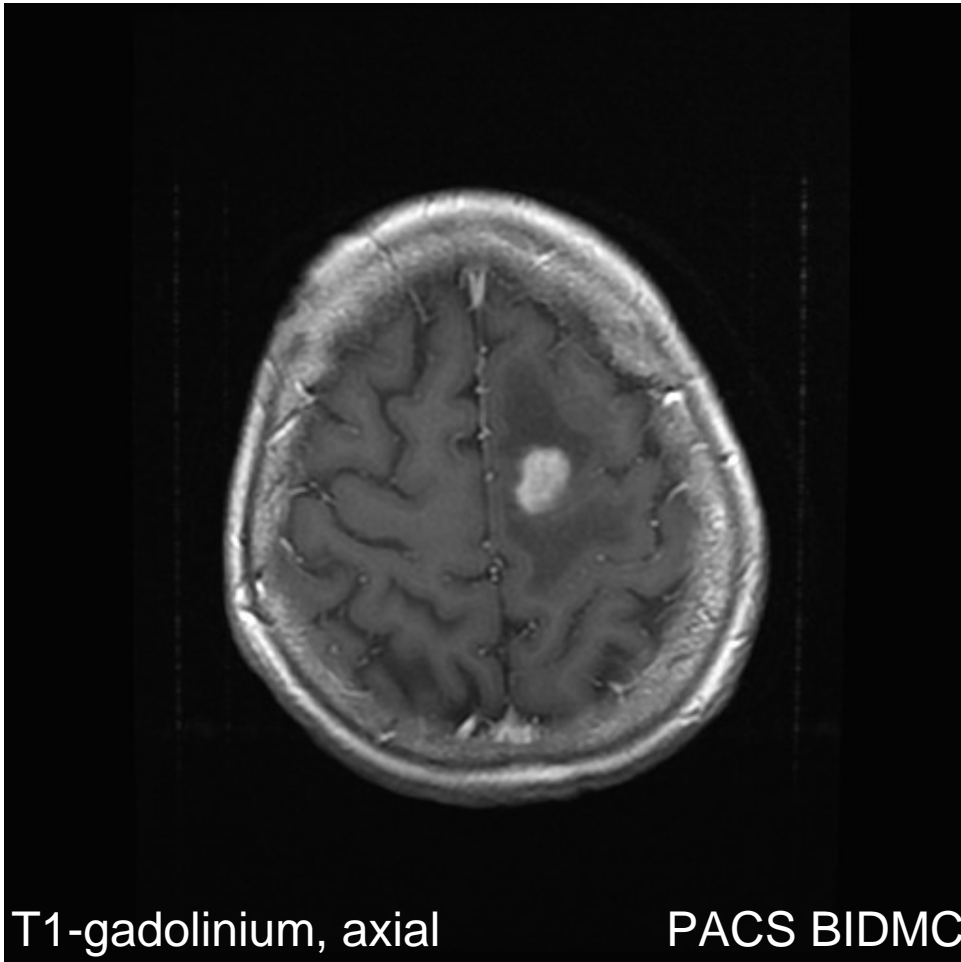
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AG: contrast-enhanced MRI, image 1, findings highlighted

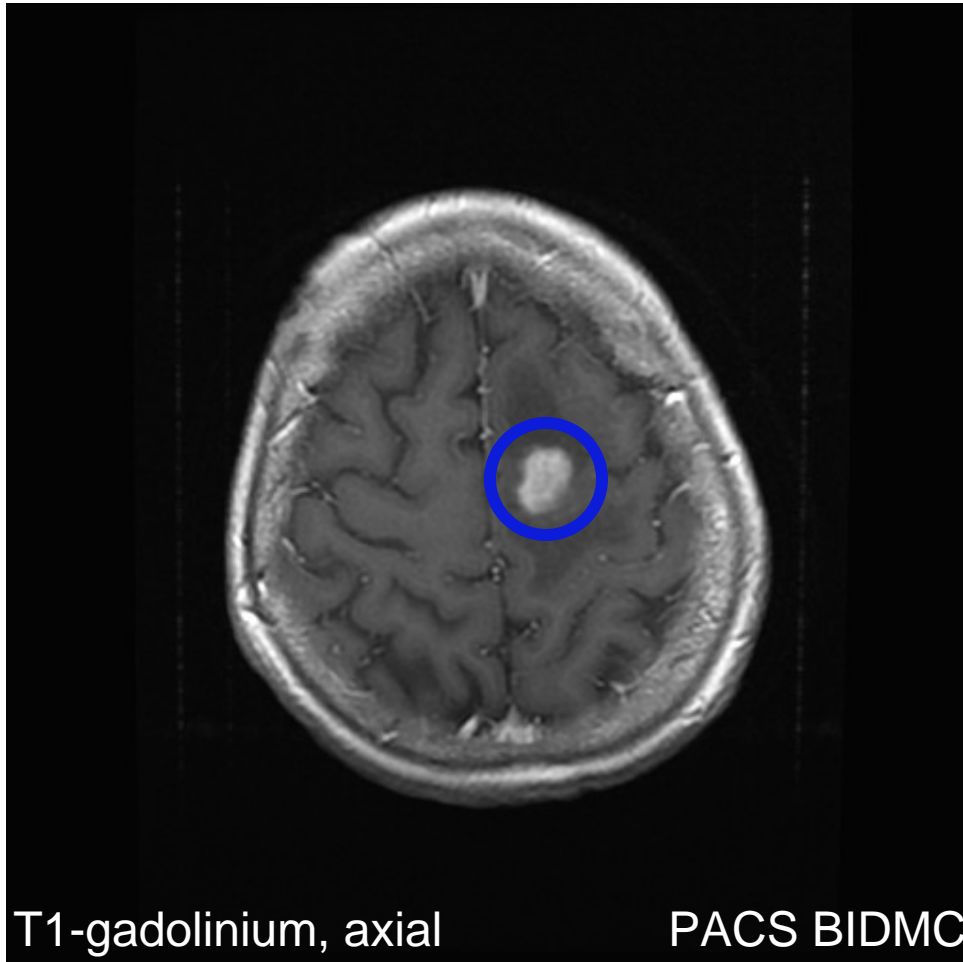


- Homogeneously enhancing mass

AG: contrast-enhanced MRI, image 2

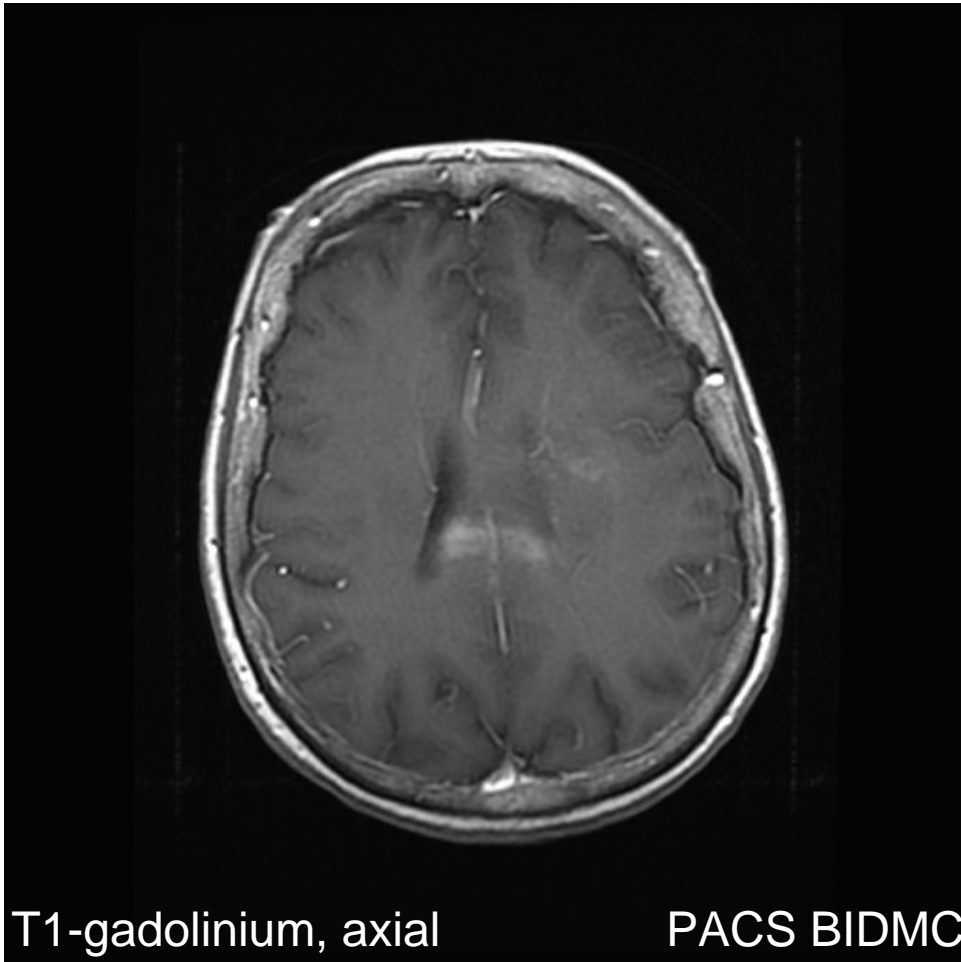


AG: contrast-enhanced MRI, image 2, highlighted findings

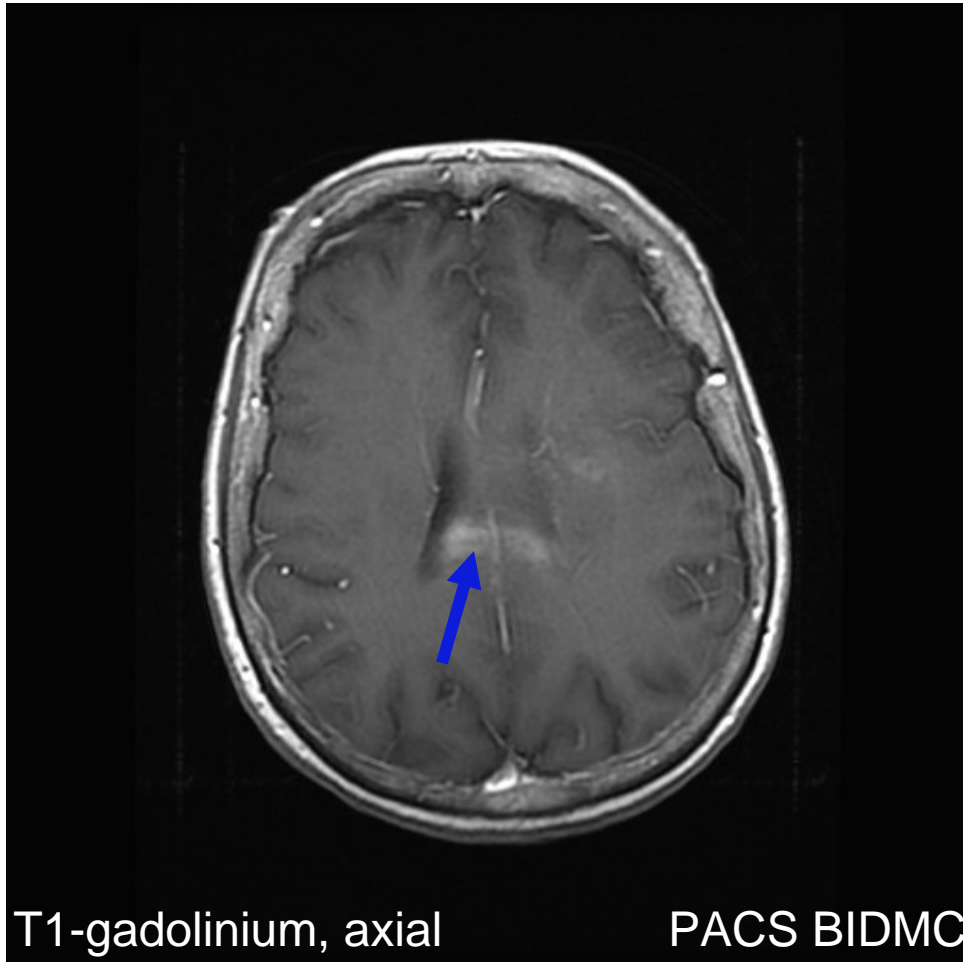


- Homogeneously enhancing mass

AG: contrast-enhanced MRI, image 3



AG: contrast-enhanced MRI, image 3, findings highlighted

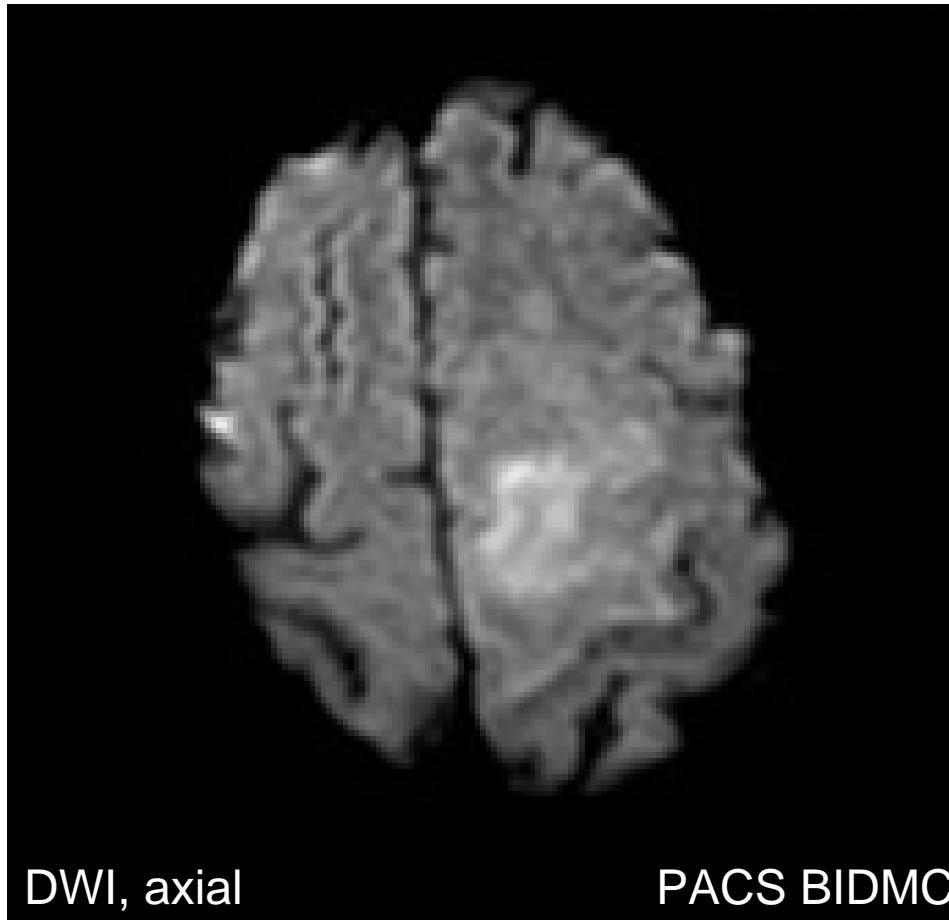


- Enhancement of the **corpus callosum**

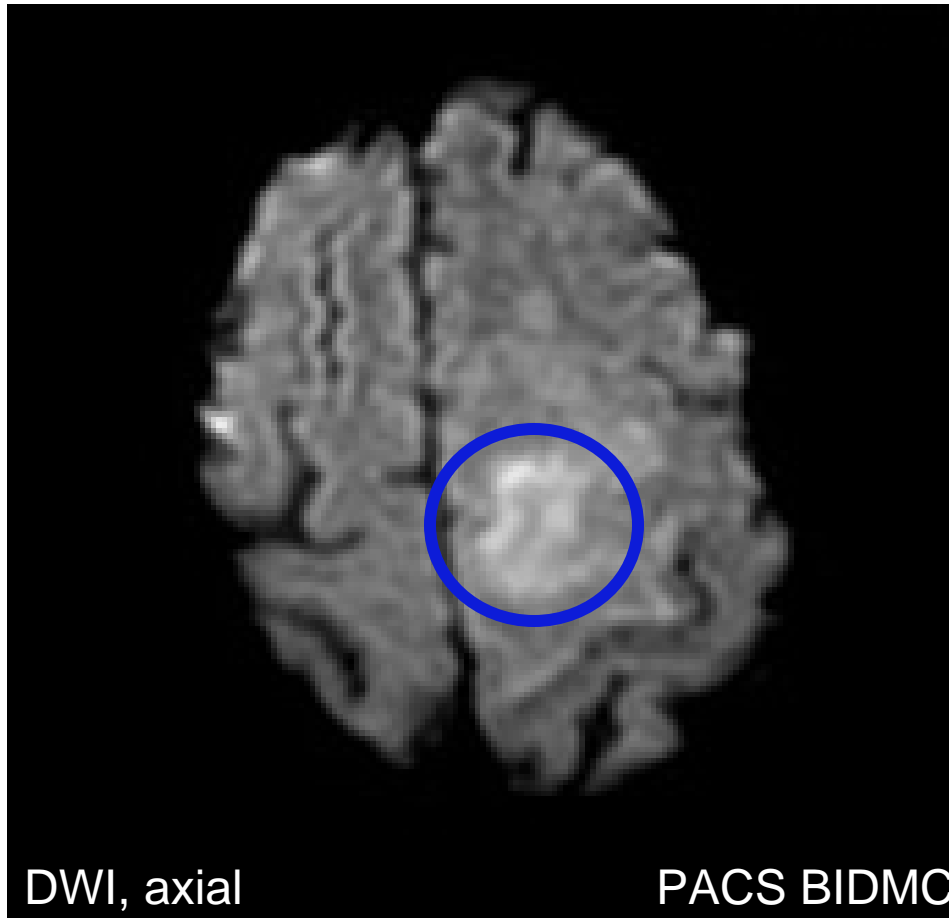
AG: Summary of findings from contrast enhanced MR images

- Homogeneously enhancing mass with involvement of the corpus callosum

AG: diffusion weighted imaging, image 1

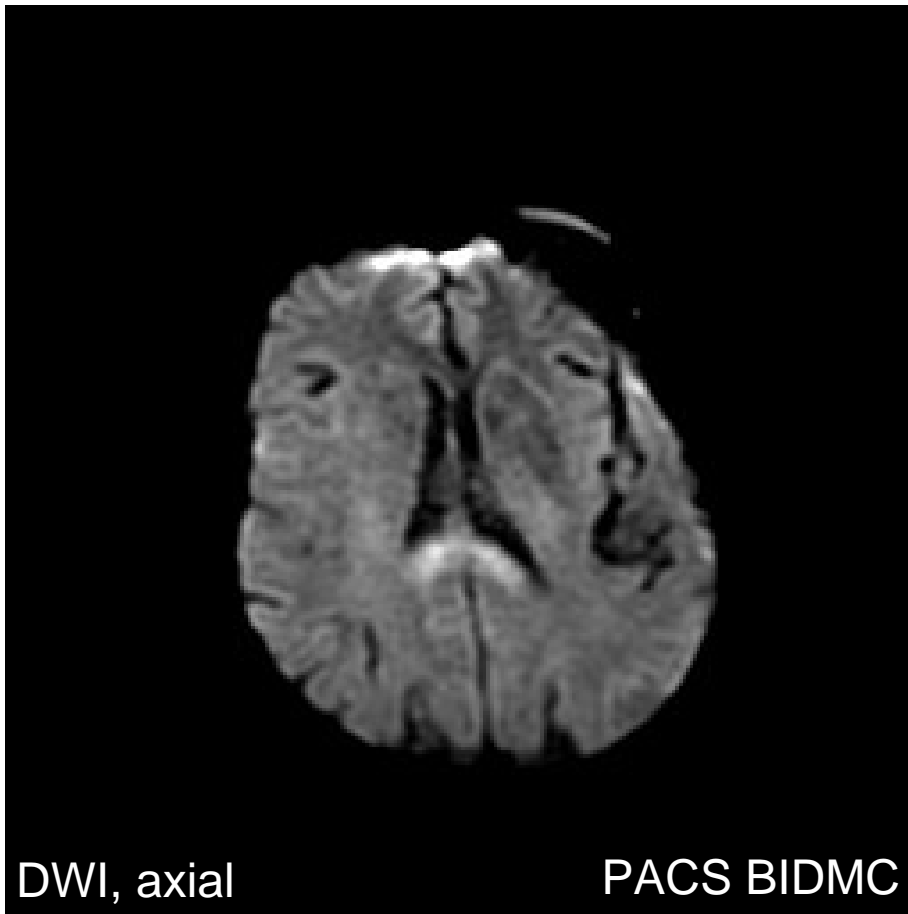


AG: diffusion weighted imaging, image 1, highlighted findings

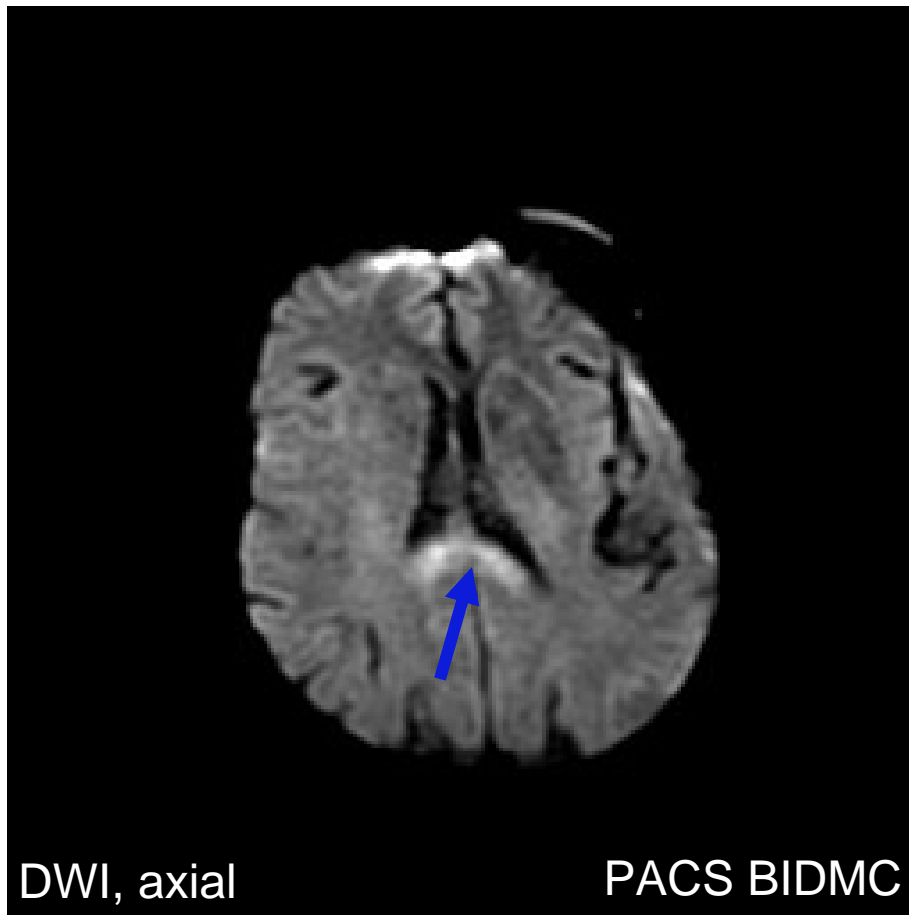


- Restricted diffusion of lesion as seen by increased signal intensity

AG: diffusion weighted imaging, image 2



AG: diffusion weighted imaging, image 2, highlighted findings



- Restricted diffusion of lesion showing corpus callosum involvement

Summary of AG's radiographic findings

- CT: isodense to hyperdense mass lesion
- MRI:
 - T2: homogeneous, hypointense signal with vasogenic edema
 - Contrast enhanced: homogeneously enhancing lesion with involvement of corpus callosum
 - DWI: restricted diffusion of lesion with corpus callosum involvement

- *Does this now help us narrow our original differential?*

Refined Differential Diagnosis for AG's brain mass

- LYMPHOMA
 - AG's radiographic findings are **classic** for CNS lymphoma
- LYMPHOMA
- LYMPHOMA
- LYMPHOMA
- LYMPHOMA
- Glioblastoma multiforme
 - Considered due to corpus callosum involvement, but usually shows T2 hyperintensity with heterogeneous enhancement
- Acute disseminated encephalomyelitis (ADEM)
 - Usually shows hyperintense T2 signal

Primary CNS Lymphoma

- Represents 3-5% of all primary brain tumors and 1% of all lymphomas
 - Increased incidence (since 1990s) in immunocompromised AND immunocompetent patients
- Immunocompromise is the only known risk factor
- Non-Hodgkin type, usually of B-cell origin
- Display high nucleus-to-cytoplasm ratio, which gives it its characteristic imaging findings:
 - CT: isodense to hyperdense mass lesion
 - MRI:
 - T2: homogeneous, hypointense signal
 - Contrast-enhanced: homogeneously enhancing lesion
 - DWI: restricted diffusion of lesion
 - Although it has characteristic imaging findings, histopathologic tissue diagnosis needed for definitive diagnosis

Primary CNS Lymphoma, continued

- Often involves cerebral hemispheres, periventricular white matter, corpus callosum, subependymal region, deep gray matter, and often the meninges
- Highly aggressive
- Treated with methotrexate-based chemotherapy with or without whole-brain radiation
 - Surgery does not improve survival
- Prognosis based on a number of factors and ranges from a 2-year overall survival of 80% to 15%
 - Negative prognostic factors include age >60, elevated serum LDH, elevated CSF protein and tumor location in deep brain structures
- Survival is 1.5 months without treatment, but is increased to 44 months with chemotherapy

Role of imaging in further diagnosis of CNS lymphoma

- Stereotactic needle biopsy
 - Overlay MRI with intra-operative CT using software to determine the coordinates for precise needle biopsy
 - This is done because it is frequently difficult accurately image the extent of lesion on CT

Back to AG: tissue diagnosis

- Primary CNS lymphoma was confirmed from tissue analysis taken by stereotactic biopsy
- She was referred to a neuro-oncologist for further care management

CNS Lymphoma in Immunocompetent vs. Immunocompromised patients

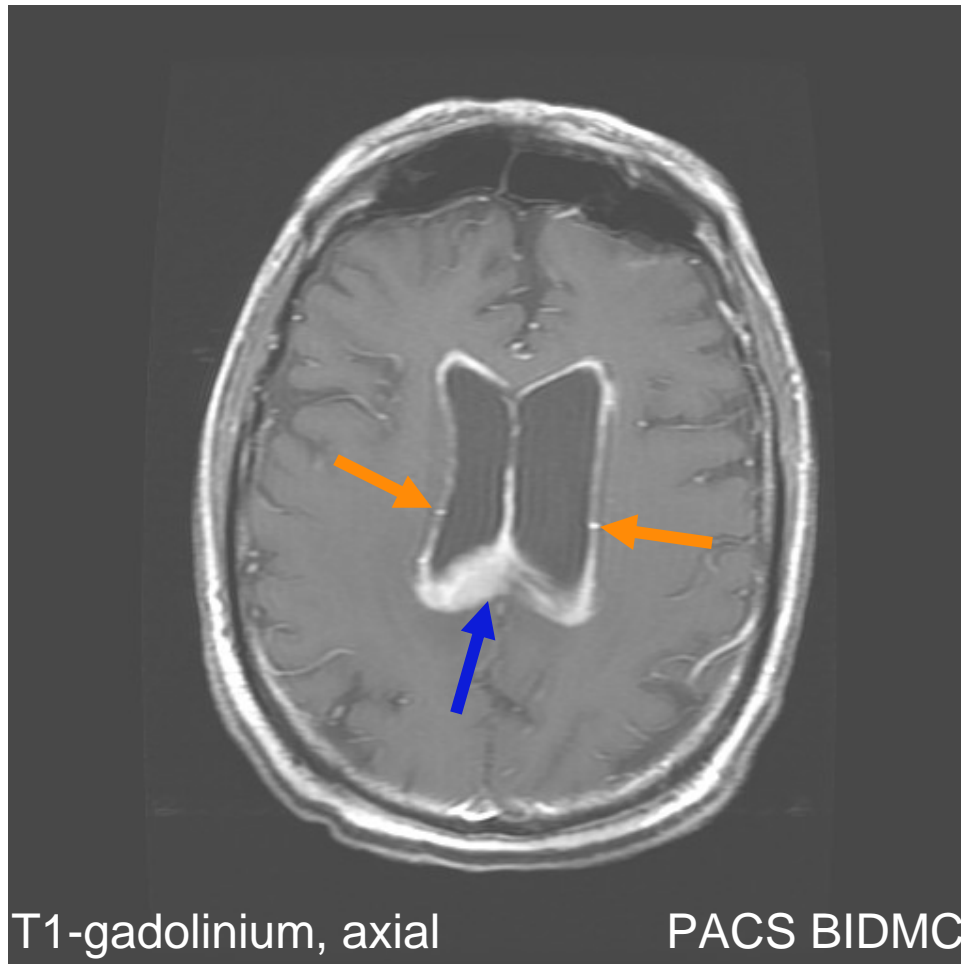
	Competent	Compromised
Mean age (yr)	60	30
Multiple lesions	30-50%	63-81%
Necrosis	Rare	Common
CT density	Hyperdense	Hyperdense
CT enhance	Homogeneous	Heterogeneous
MR T1 signal	Iso- to hypo-	Iso- to hypo-
MR T2 signal	Iso- to hypo-	Iso- to hypo-
MR enhance	Homogeneous	Heterogeneous

CNS Lymphoma in Immunocompromised patients

- In immunocompromised patients, there can be atypical disease location (brainstem, cranial nerves, cavernous sinuses)
- In immunocompromised patients, lymphoma can resemble abscess and toxoplasmosis
 - If considering lymphoma vs. toxoplasmosis
 - Favor lymphoma if unifocal and toxo if multifocal
 - May have to perform PET imaging
 - Increased glucose uptake in lymphoma, decreased uptake in toxo
 - If lymphoma vs. abscess (heterogeneous peripherally enhancing mass on T2-weighted images)
 - Abscess may have thin, hypointense rim due to free radicals on T2-weighted images

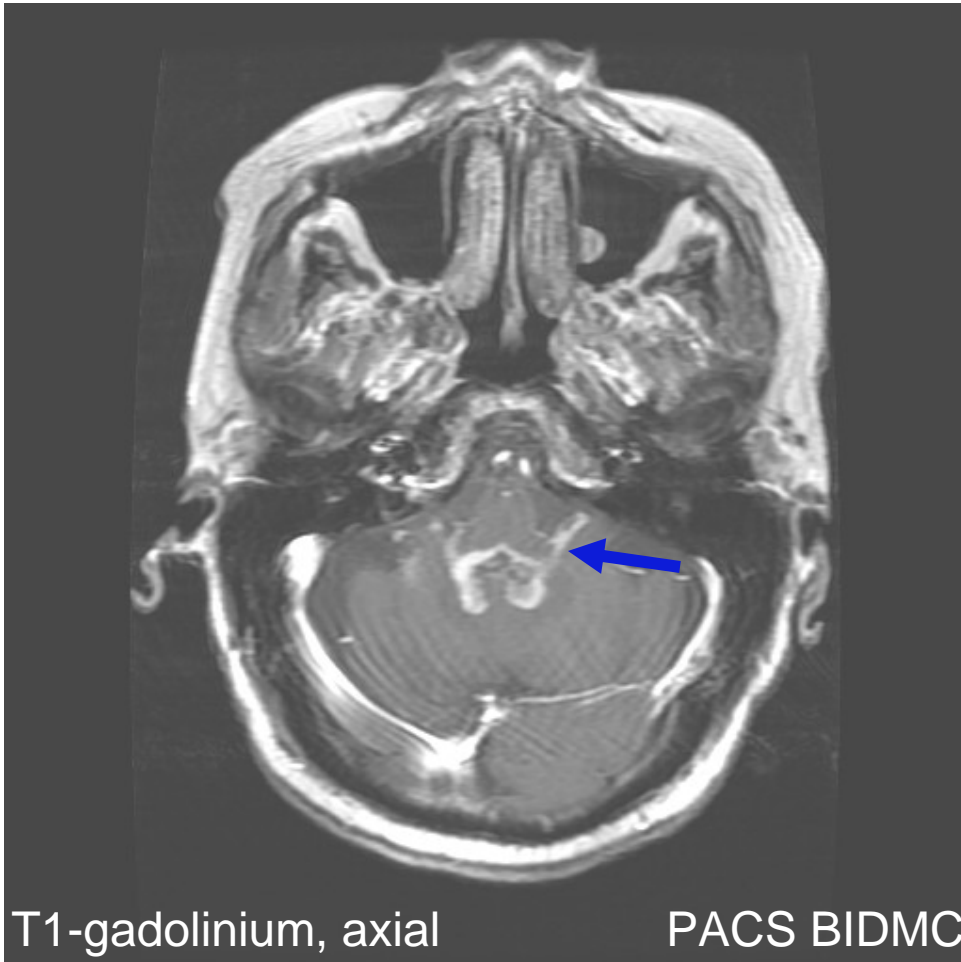
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- Let's review the common findings of primary CNS lymphoma again, using a companion patient, LM

Companion patient: LM, contrast enhanced MRI



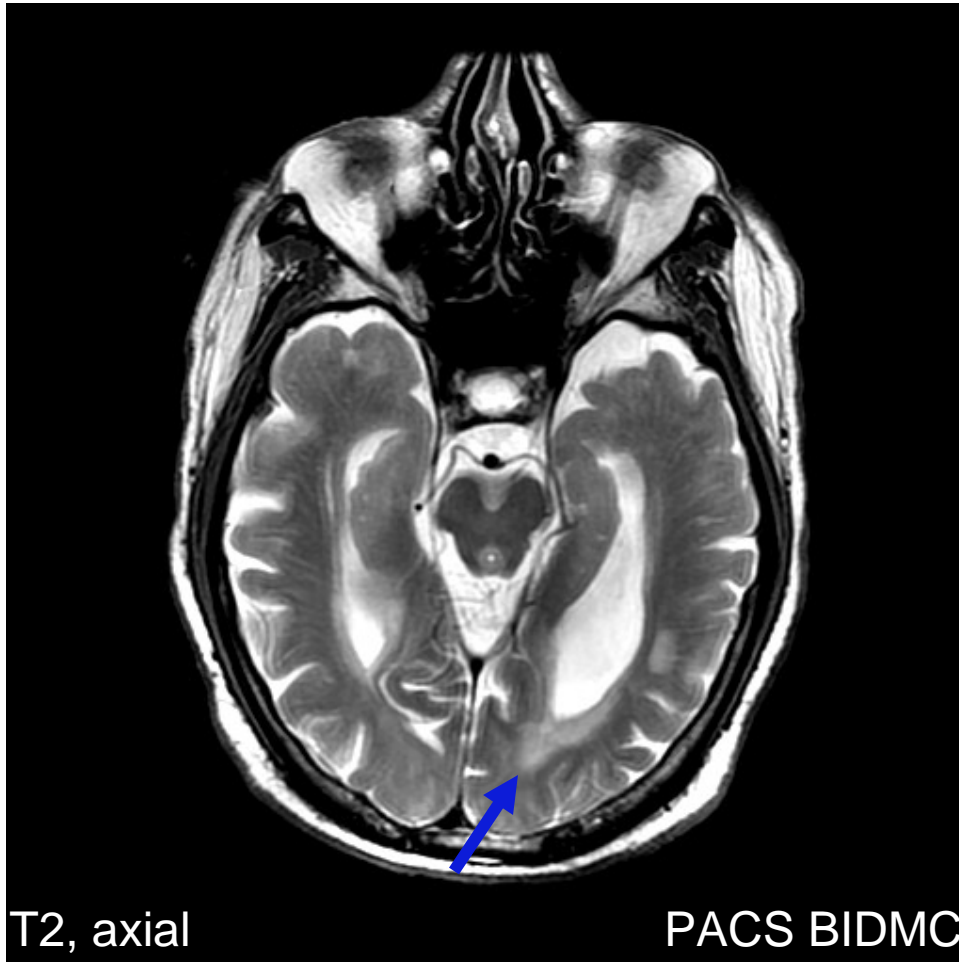
- Enhancement in **subependymal** distribution with extension into the **corpus callosum**

LM: leptomeningeal involvement



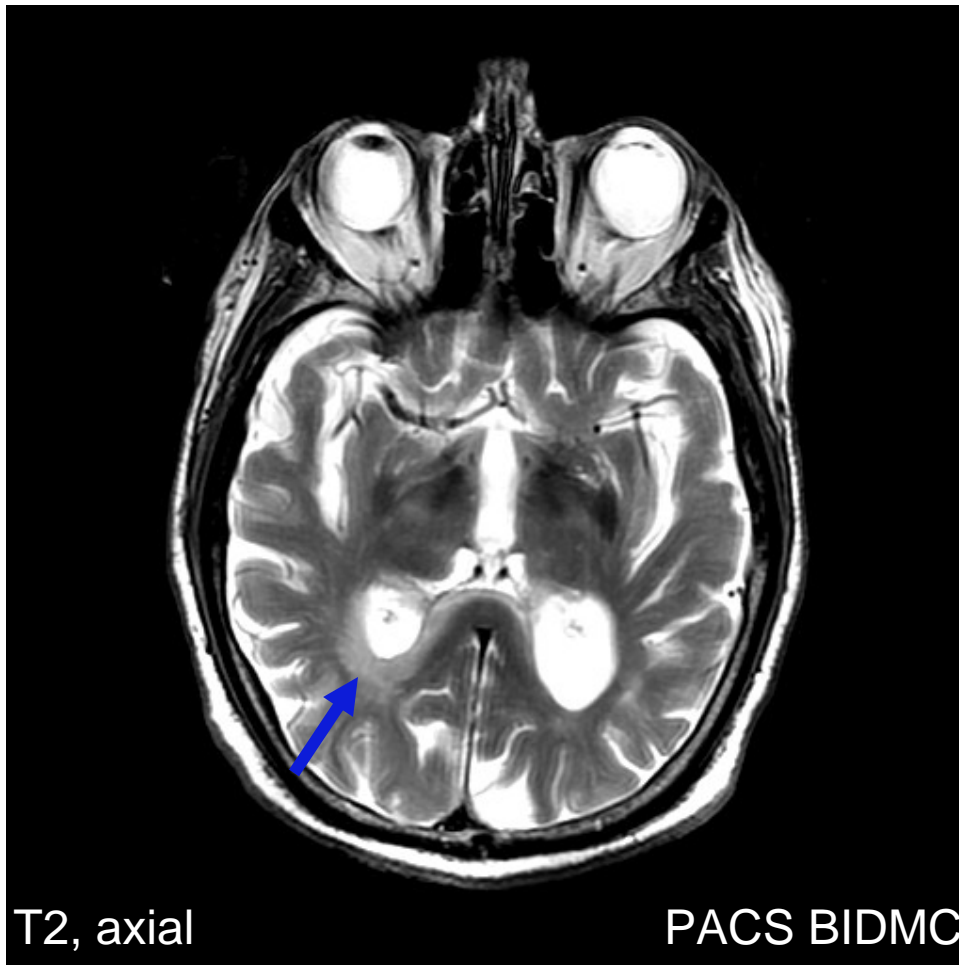
- Enhancement of leptomeninges

LM: Head MRI, image 1



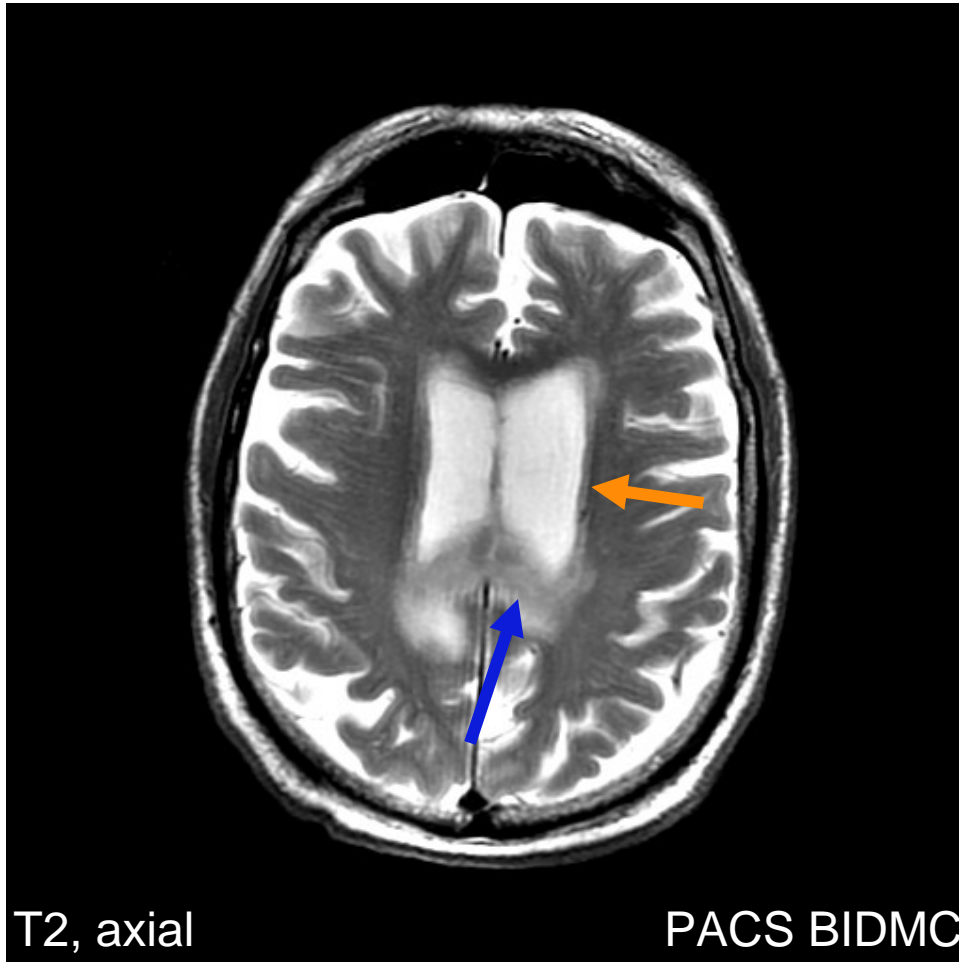
- Hypointense periventricular signal

LM: Head MRI, image 2



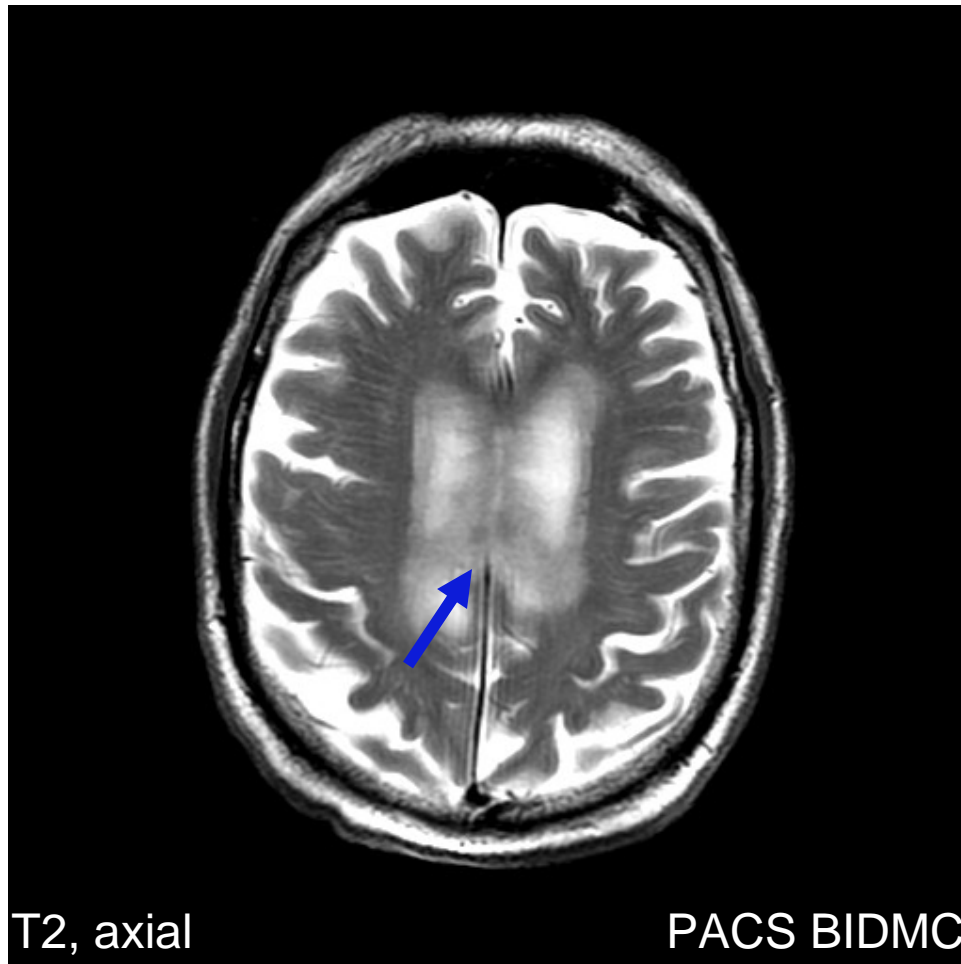
- Hypointense periventricular signal

LM: Head MRI, image 3



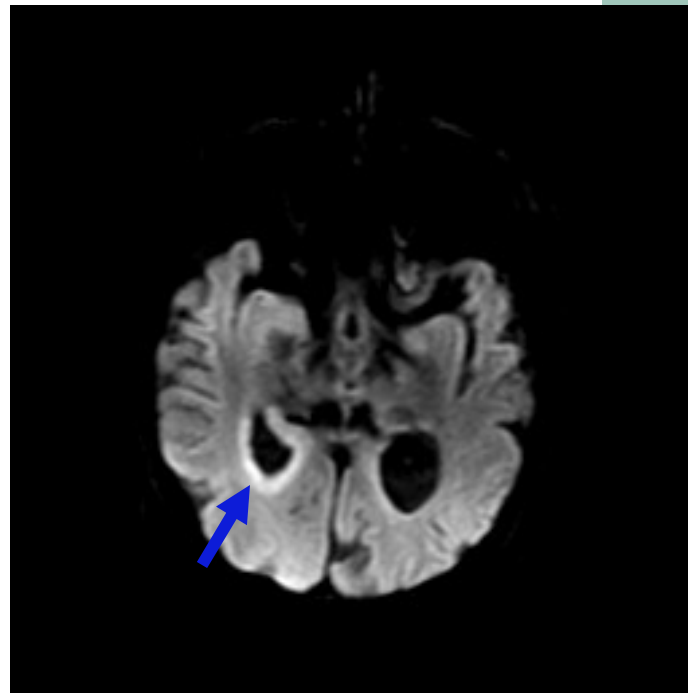
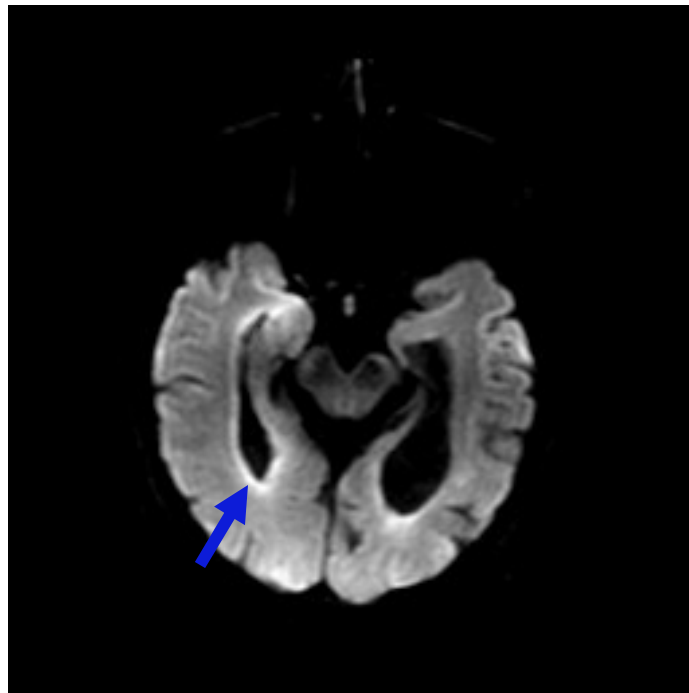
- Hypointense signal in subependymal spaces and corpus callosum

LM: Head MRI, image 4



- Hypointense signal in corpus callosum

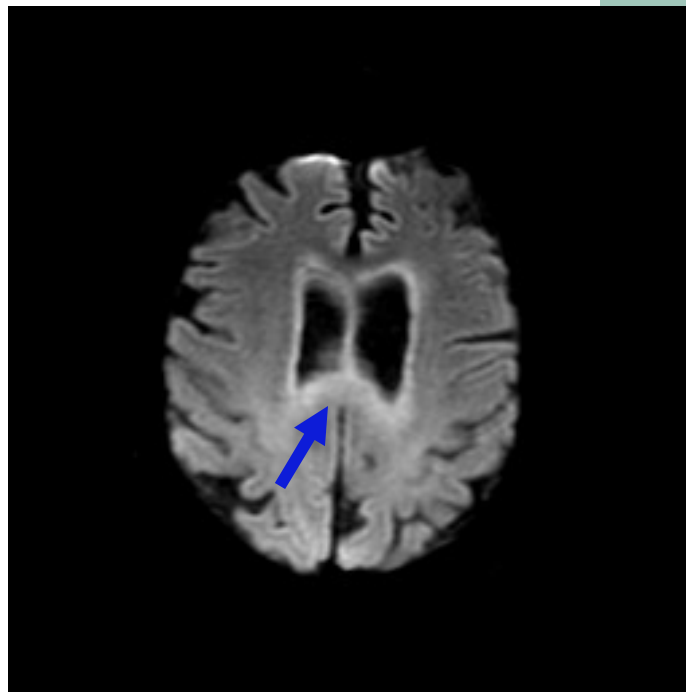
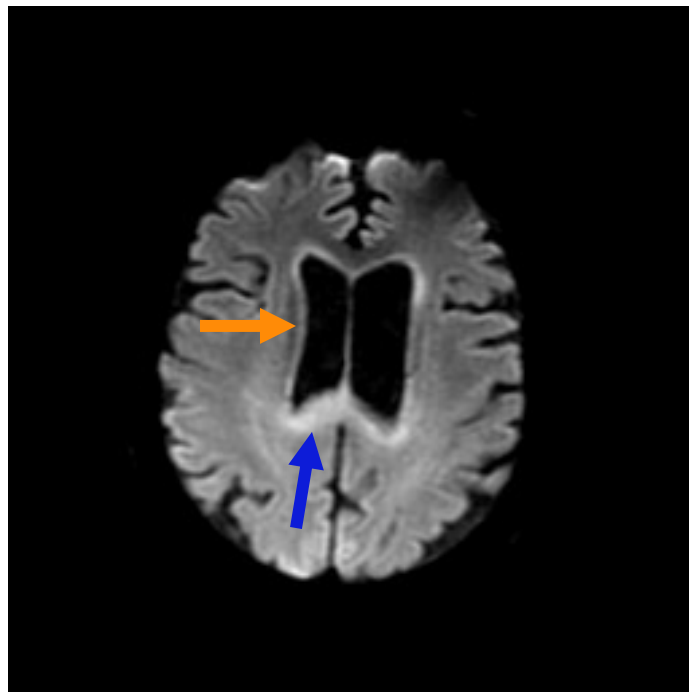
LM: diffusion weighted images



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- Restricted diffusion in **periventricular** distribution

LM: more diffusion weighted images



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- Restricted diffusion in **subependymal** distribution with extension into the **corpus callosum**

Summary of LM's radiographic findings

- Periventricular and subependymal involvement with extension into the corpus callosum
- T1 contrast-enhanced: uniform enhancement
- T2 weighted: hypointense signal
- DWI: restricted diffusion

Review of the radiologic features of primary CNS lymphoma

- CT: isodense to hyperdense lesion
- MRI:
 - T2 weighted: homogeneous, hypointense signal
 - Can be heterogeneous if patient is immunocompromised
 - Contrast enhanced T1: homogeneously enhancing lesion
 - DWI: restricted diffusion of lesion
- Typically involves cerebral hemispheres, corpus callosum, periventricular white matter, subependymal region
 - Atypical locations in immunocompromised patients

Summary

- Discussed the differential diagnosis of brain masses
- Familiarized with the common imaging features of primary CNS lymphoma on both CT and MRI
- Discussed differences in imaging features of primary CNS lymphoma between immunocompetent and immunocompromised patients
- Gained an understanding for the role of imaging in primary CNS lymphoma

Many Thanks!

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- Maria Levantakis

References

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