Vasari MRI Visual Feature Guide

Sample images derived from the Rembrandt MRI examinations contributed by Thomas Jefferson University Hospital

caBIG ® Cancer Biomedical Informatics Grid ®

Thomas Jefferson University | Jefferson Medical College

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Purpose

- VASARI is a controlled vocabulary for describing the baseline visual features of human gliomas on clinical MRI.
- This visual reference will serve as a guide for applying the VASARI MR feature set for human gliomas.
- This comprehensive list contains visual examples of the 24 most common features used to describe primary cerebral neoplasia on standard contrast enhanced MR imaging.
  - This excludes advanced MR imaging features such as DSC, MT, MRS, DTI and perfusion/permeability.
- To be used as a reference by expert reviewers as a guideline for scoring visual MR features.
- Images selection based upon scoring from consensus of three expert neuroradiologists from 33 individual glioma cases contributed to the NCI Rembrandt collection from Thomas Jefferson University Hospital.

Guidelines

- Each visual MR feature is represented by a feature number (e.g. f1, f2 etc.).
- Each feature has a name as listed in the title bar.
- A description of the feature and the appropriate response criteria are listed in the blue text box.
- Representative images for each of the available feature responses are shown with the consensus scored response below.
  - In some instances, no specific examples of a particular imaging feature response existed in the dataset and therefore are not shown.
- *Scoring of any of the Vasari features requires assessment of the entire dataset including all pulse sequences.*
  - This is important for features that estimate proportion (e.g 33-66%).
  - While this guideline focused primarily on the axial imaging, you should freely utilize other orthogonal planes as needed.

Markup & Measurement

- The *markup* should consist of a single irregular polygon which circumscribes the perimeter of the FLAIR abnormality on a single axial image that demonstrates the largest cross sectional area.

- The measurements (f29 & f30) should consist of the longest diameter and it's perpendicular.

- There is a single markup to correspond with each set of annotations.

f1 -Tumor Location

Location of lesion geographic epicenter; the largest component of the tumor (either CET or nCET) (select one only).
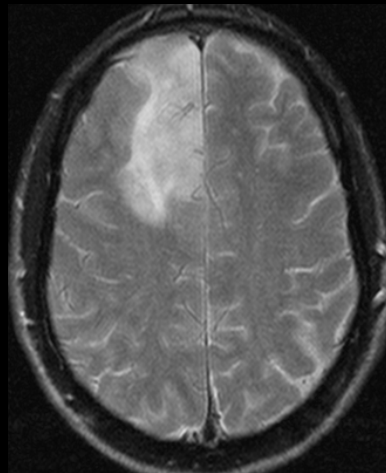
Frontal - 1
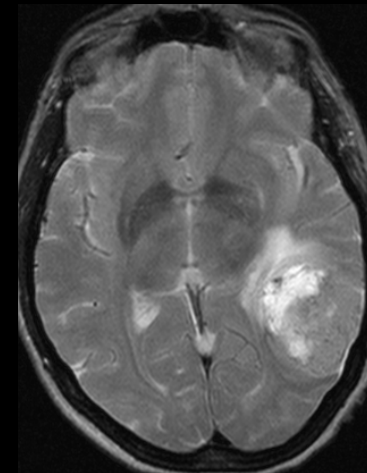
Temporal - 2
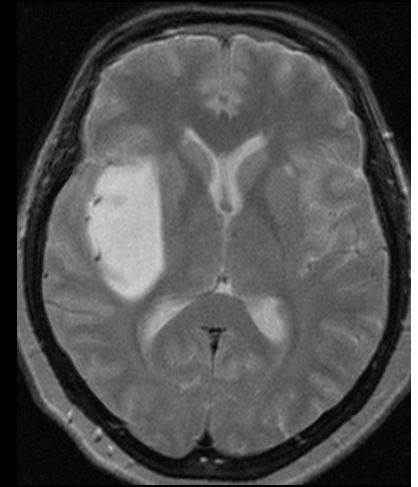
Insular -3
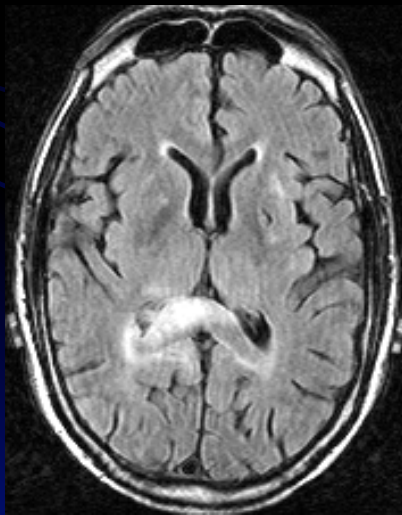
Corpus Callosum
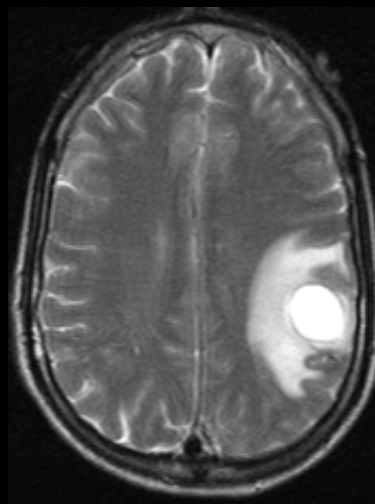
Parietal - 4
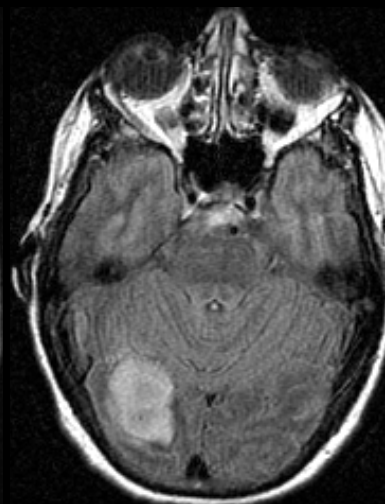
Occipital - 5
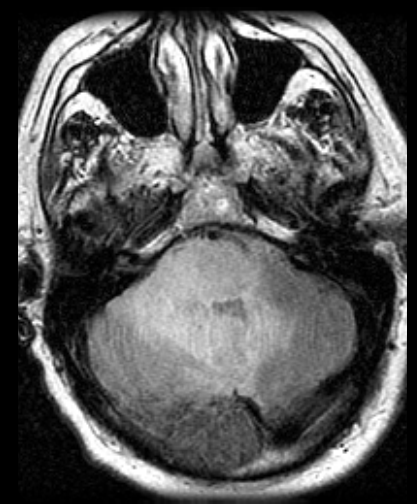
Brainstem - 6

f2 – Side of Lesion Center
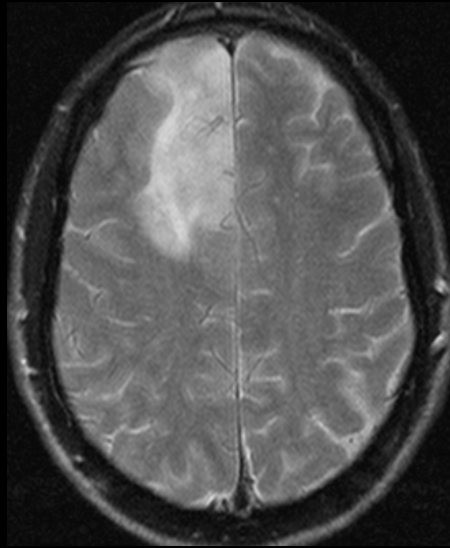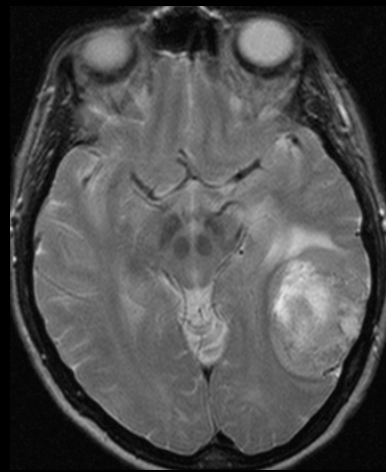

Right - 1
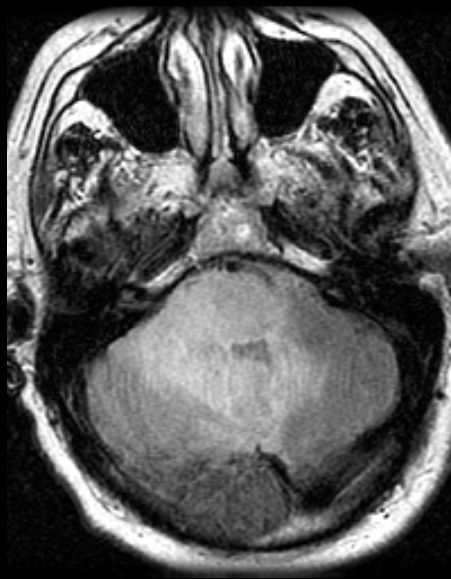
Center/Bilateral - 2
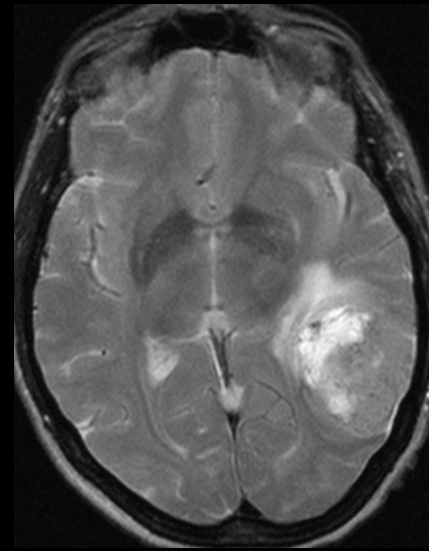
Left -3
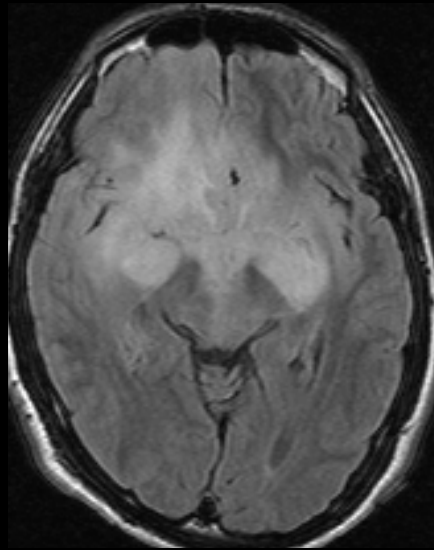
Side of lesion epicenter
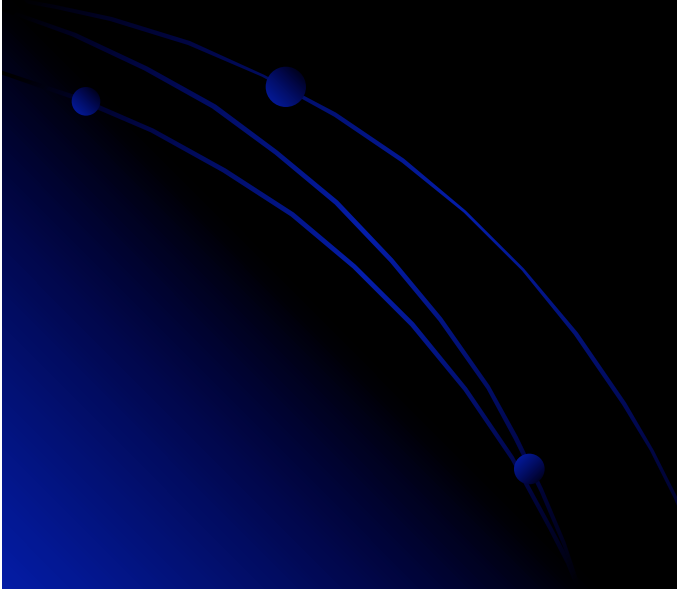
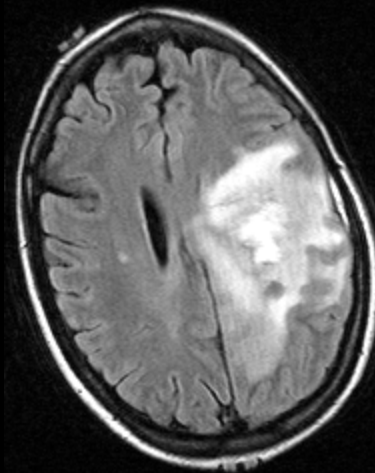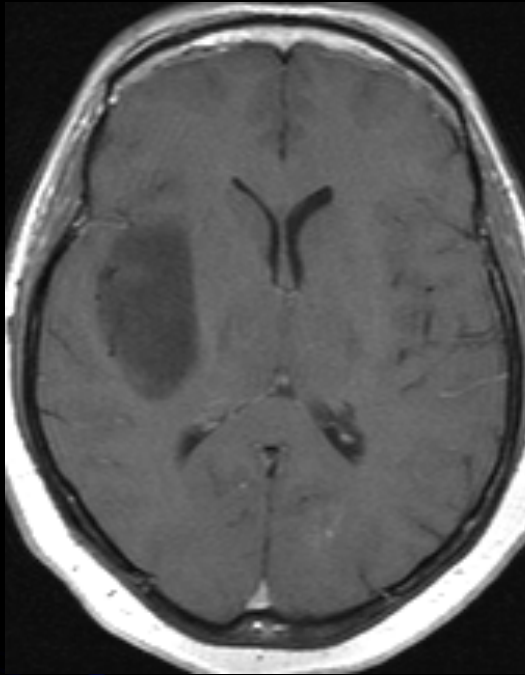# F3 – Eloquent Brain
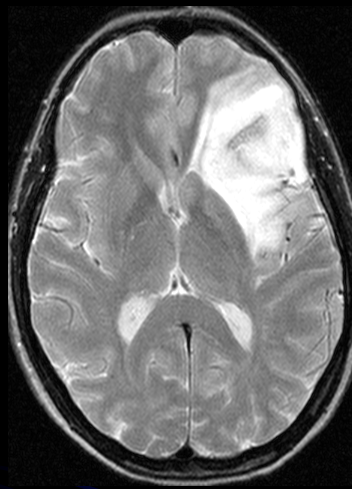
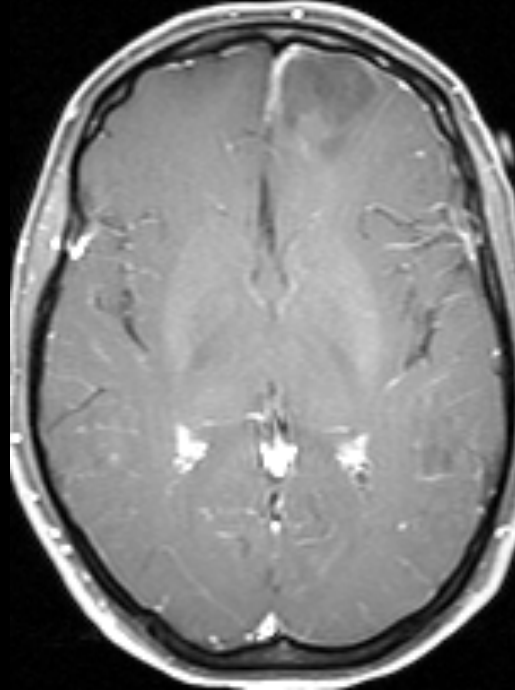2 - Speech Motor   3 - Speech Receptive   4 – Motor   5 - Vision

Does any component of the tumor (CET or nCET) involve eloquent cortex or the immediate subcortical white matter of eloquent cortex (motor,language, vision)? (multiple selections acceptable).
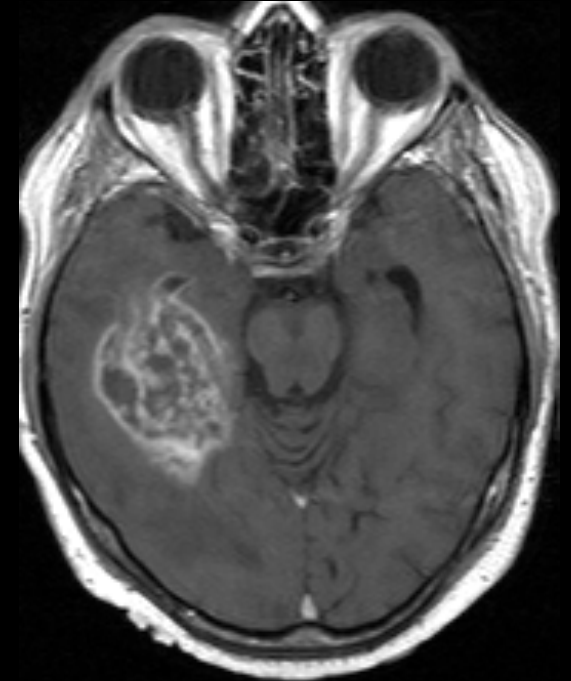
f4 – Enhancement Quality

1 - None

2 – Minimal/Mild

3 – Marked/Avid

Qualitative degree of contrast enhancement is defined as having all or portions of the tumor that demonstrate significantly higher signal on the postcontrast T1W images compared to precontrast T1W images. **Mild/minimal** = when barely discernable degree of enhancement is present relative to pre-contrast images. **Marked/avid** = obvious tissue enhancement.
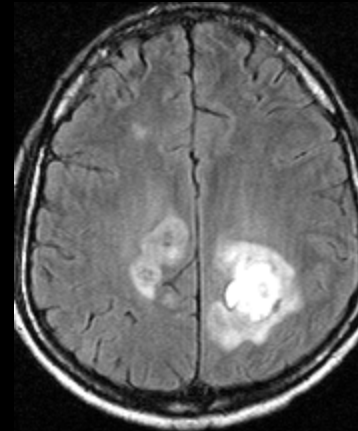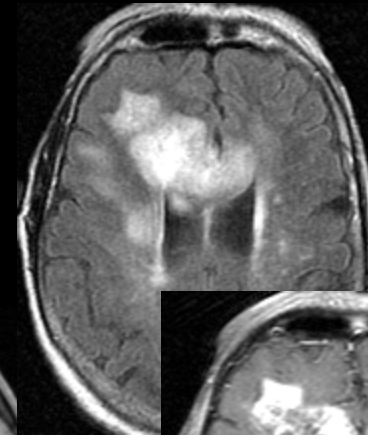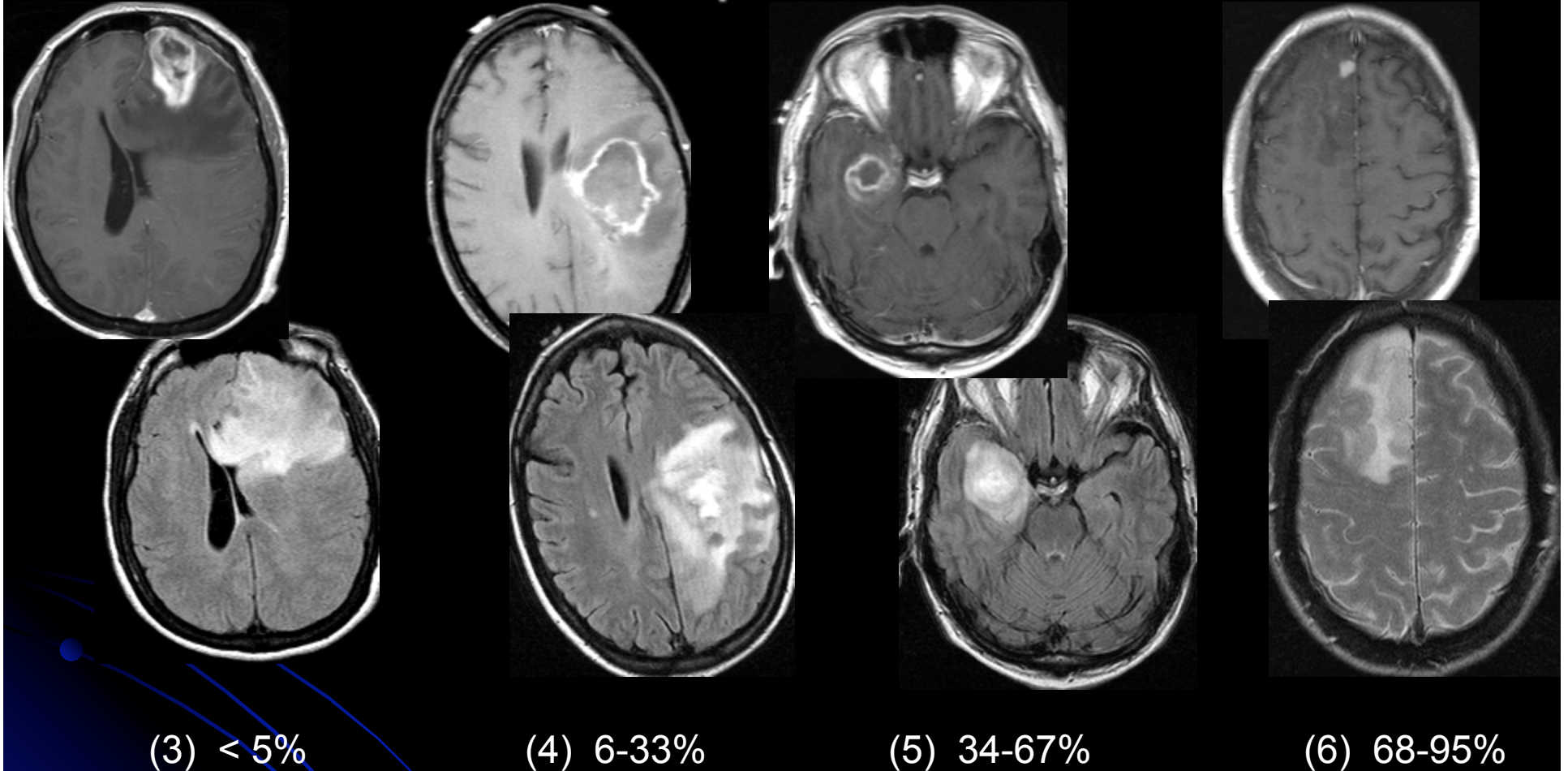
f5 – Proportion Enhancing
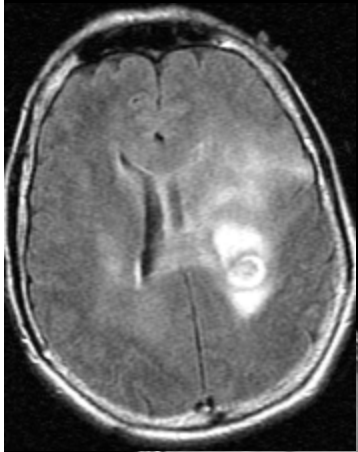
(3) < 5%   (4) 6-33%   (5) 34-67%   (6) 68-95%
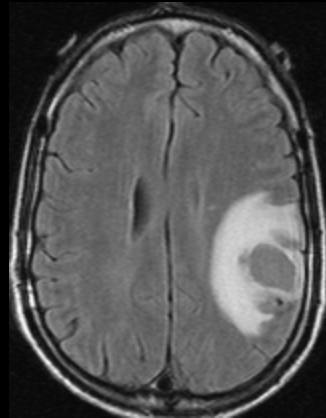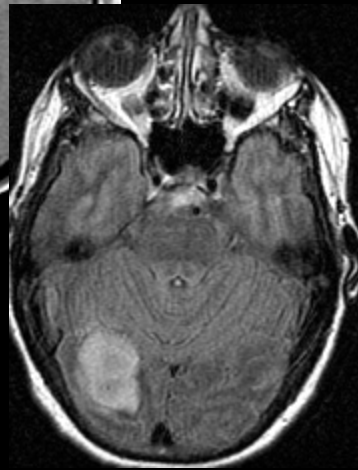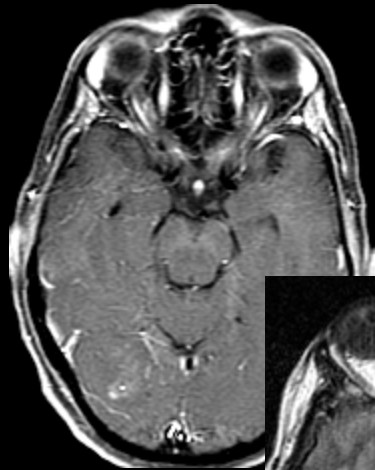
Visually, when scanning through the entire tumor volume, what proportion of the entire tumor would you estimate is **enhancing.** (Assuming that the entire abnormality may be comprised of: (1) an enhancing component, (2) a non-enhancing component, (3) a necrotic component and (4) a edema component.)
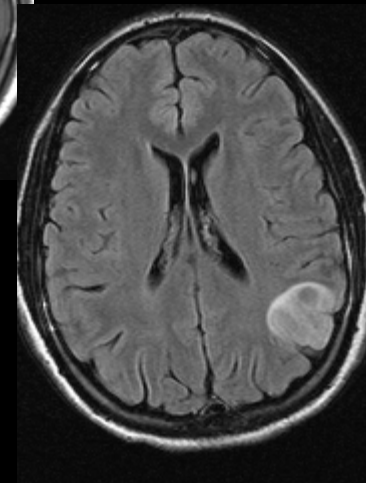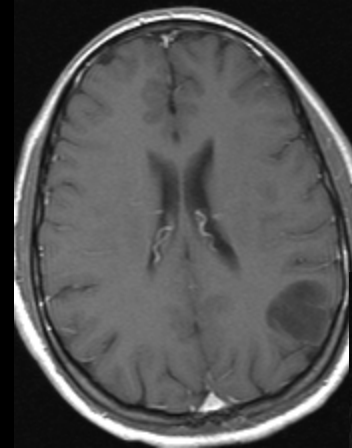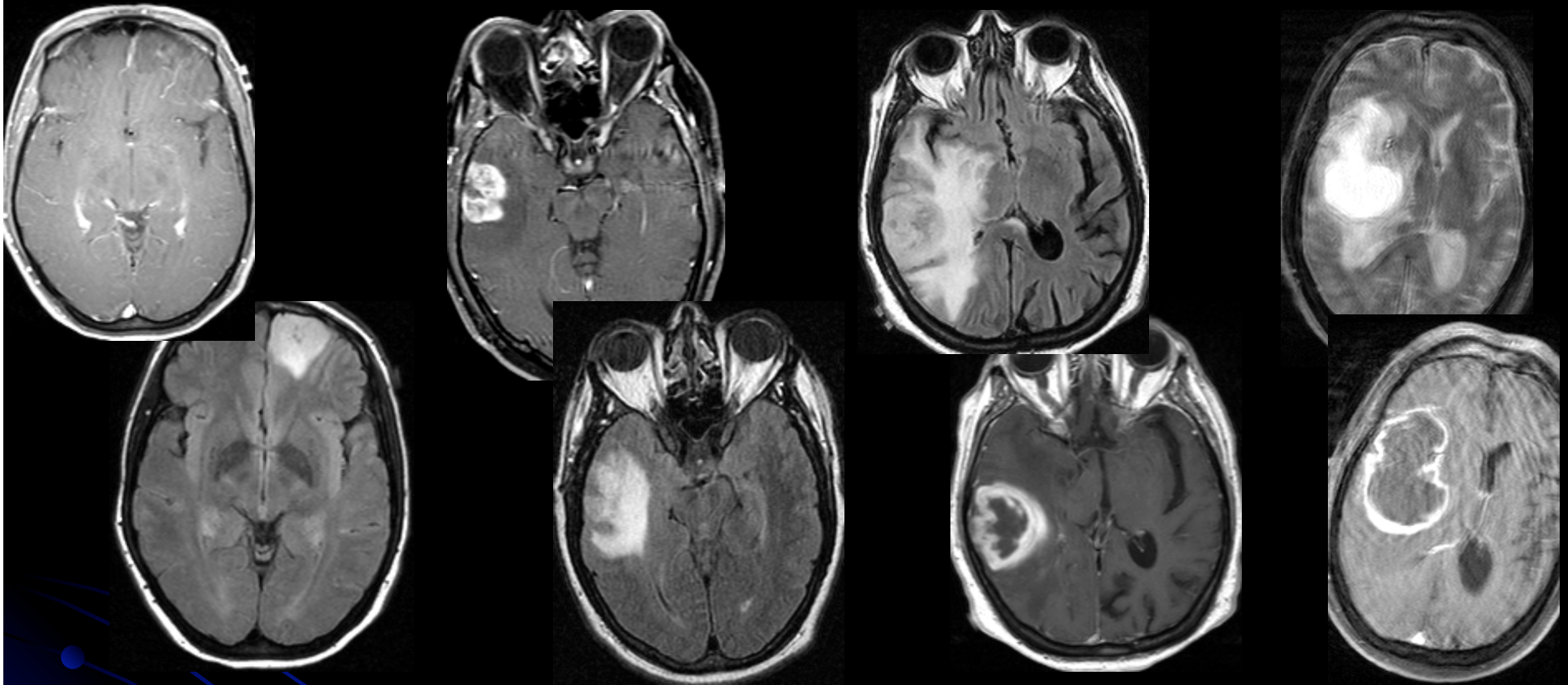
f6 – Proportion nCET

(3) < 5%   (4) 6-33%   (5) 34-67%   (6) 68-95%

Visually, when scanning through the entire tumor volume, what proportion of the entire tumor is estimated to represent non-enhancing tumor (not edema)? Non-enhancing tumor is defined as regions of T2W hyperintensity (less than the intensity of cerebrospinal fluid, with corresponding T1W hypointensity) that are associated with mass effect and architectural distortion, including blurring of the gray-white interface.(Assuming that the the entire abnormality may be comprised of: (1) an enhancing component, (2) a non-enhancing component, (3) a necrotic component and (4) a edema component.)

f6 – Proportion nCET

(7) < 95%

(8) 100%

Visually, when scanning through the entire tumor volume, what proportion of the entire tumor is estimated to represent non-enhancing tumor (not edema)? Non-enhancing tumor is defined as regions of T2W hyperintensity (less than the intensity of cerebrospinal fluid, with corresponding T1W hypointensity) that are associated with mass effect and architectural distortion, including blurring of the gray-white interface.(Assuming that the the entire abnormality may be comprised of: (1) an enhancing component, (2) a non-enhancing component, (3) a necrotic component and (4) a edema component.)

f7 – Proportion Necrosis

(2) None   (3) < 5%   (4) 6-33%   (5) 34-67%

Visually, when scanning through the entire tumor volume, what proportion of the tumor is estimated to represent necrosis. Necrosis is defined as a region within the tumor that does not enhance or shows markedly diminished enhancement, is high on T2W and proton density images, is low on T1W images, and has an irregular border). (Assuming that the entire abnormality may be comprised of: (1) an enhancing component, (2) a non-enhancing component, (3) a necrotic component and (4) a edema component.)

f8 – Cysts
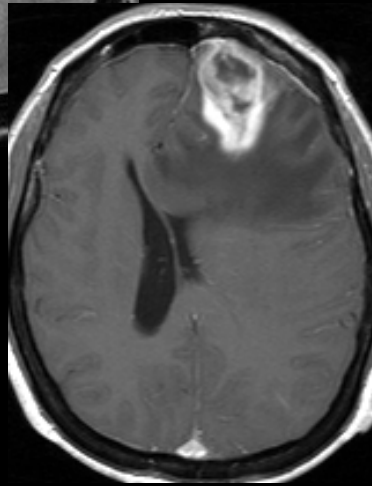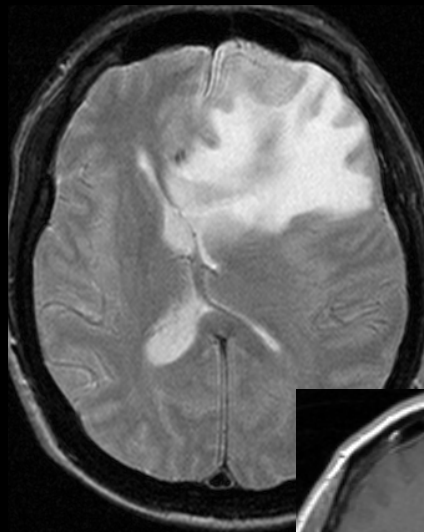
(1) No
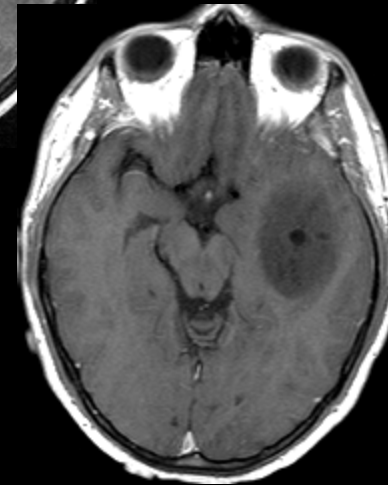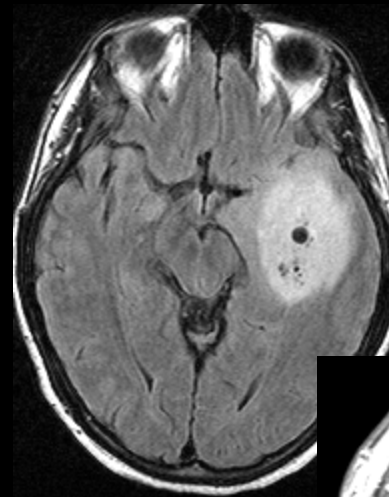
(2) Yes

Cysts are well defined, rounded, often eccentric regions of very bright T2W signal and low T1W signal essentially matching CSF signal intensity, with very thin, regular, smooth, nonenhancing or regularly enhancing walls, possibly with thin, regular, internal septations

f9 – Multifocal or Multicentric
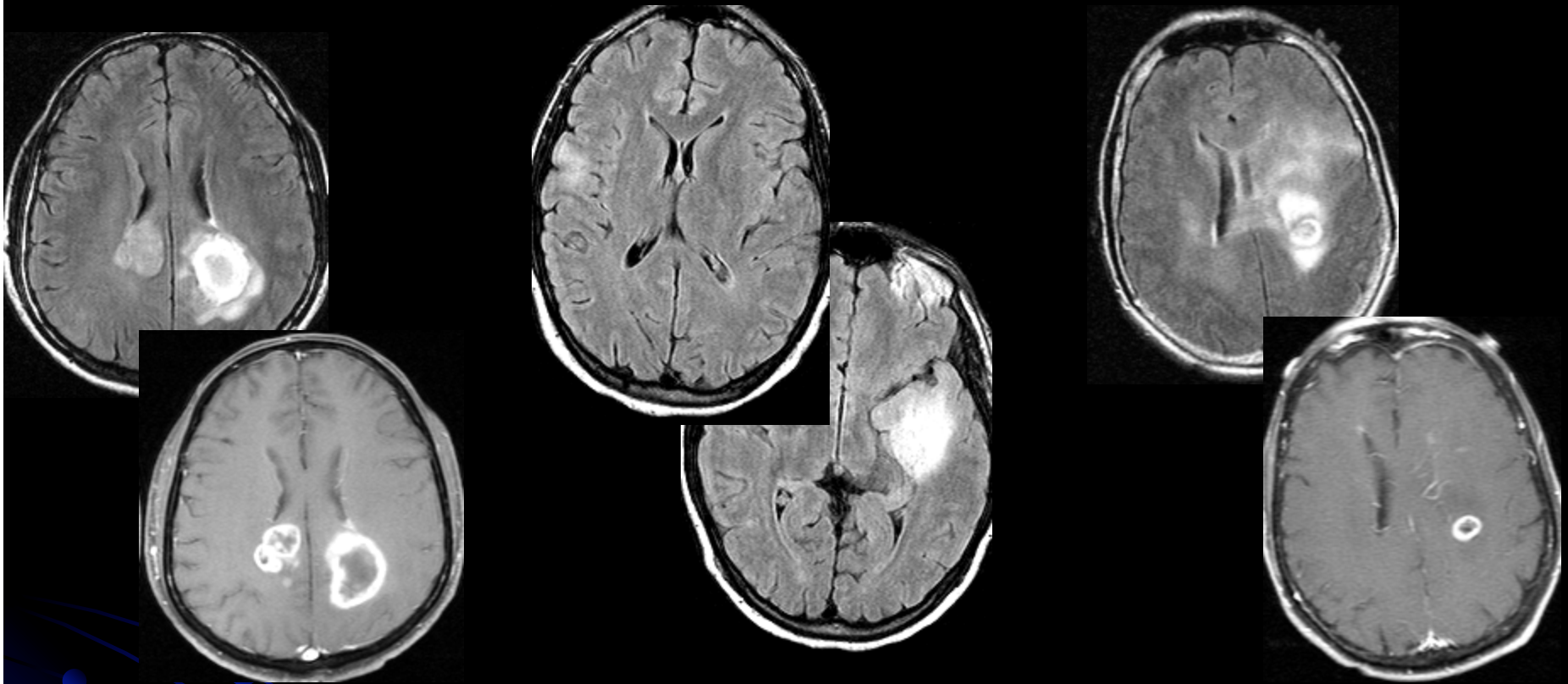
(2) Multifocal   (3) Multicentric   (4) Gliomatosis

Multifocal is defined as having at least one region of tumor, either enhancing or nonenhancing, which is not contiguous with the dominant lesion and is outside the region of signal abnormality (edema) surrounding the dominant mass. This can be defined as those resulting from dissemination or growth by an established route, spread via commissural or other pathways, or via CSF channels or local metastases, whereas **Multicentric** are widely separated lesions in different lobes or different hemispheres that cannot be attributed to one of the previously mentioned pathways. **Gliomatosis** refers to generalized neoplastic transformation of the white matter of most of a hemisphere.

f10 – T1/FLAIR ratio
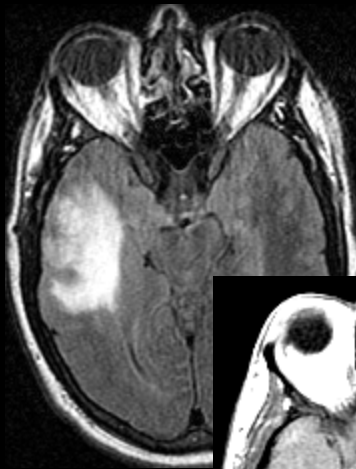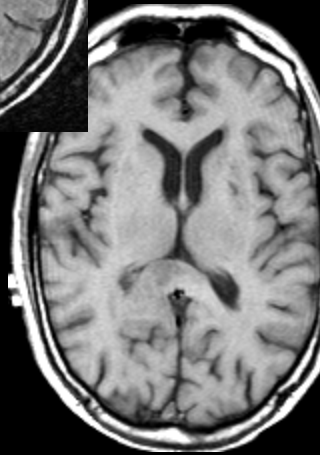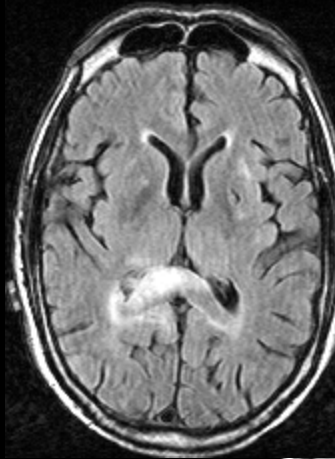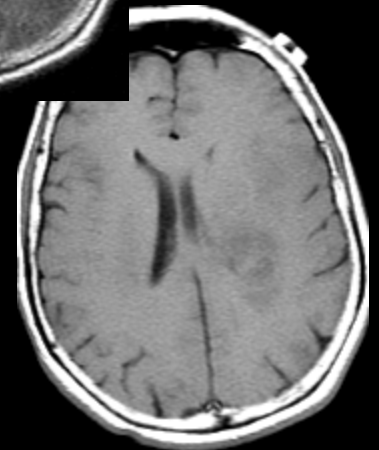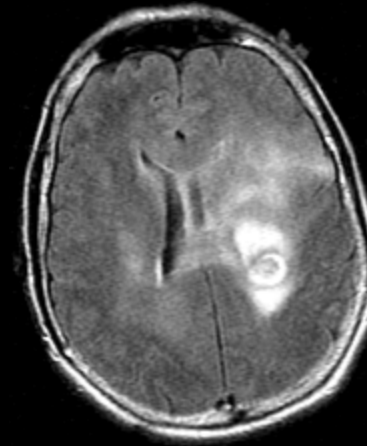
(1) Expansive   (2) Mixed   (3) Infiltrative

Expansive = size of pre-contrast T1 abnormality (exclusive of signal intensity) approximates size of FLAIR abnormality. Mixed = Size of T1 abnormality moderately less than FLAIR envelope; Infiltrative = Size of pre-contrast T1 abnormality much smaller than size of FLAIR abnormality. (Use T2 if FLAIR is not provided)

f11 – Thickness of enhancing margin
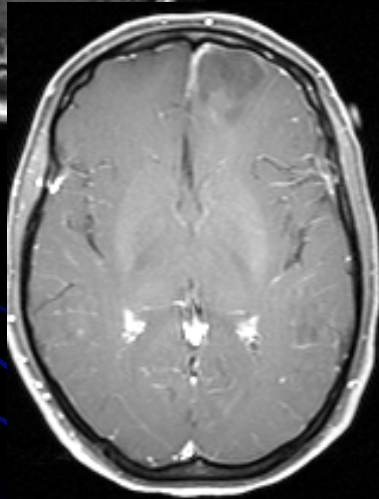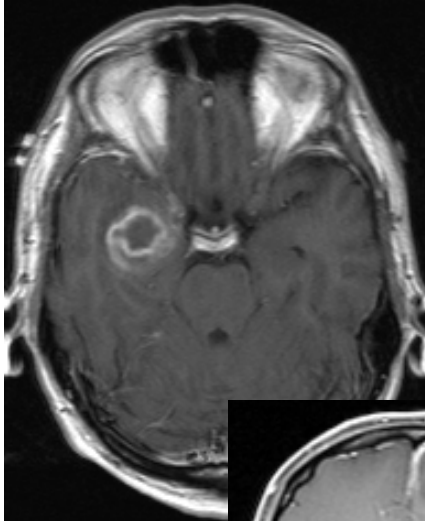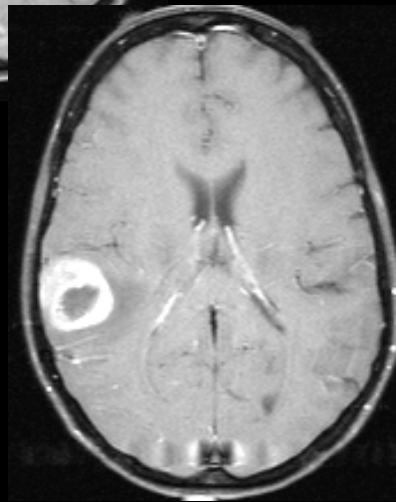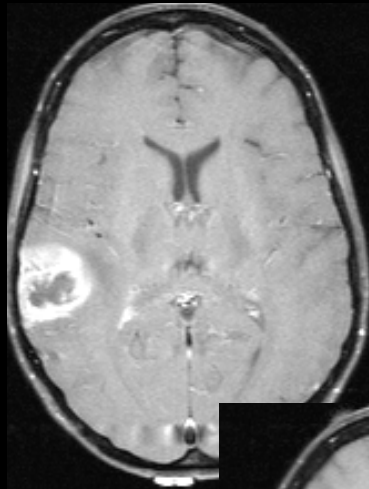
(3) Thin (< 3 mm)   (4) Thick/nodular (=> 3 mm)   () Solid
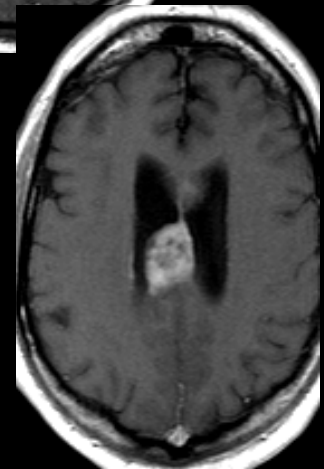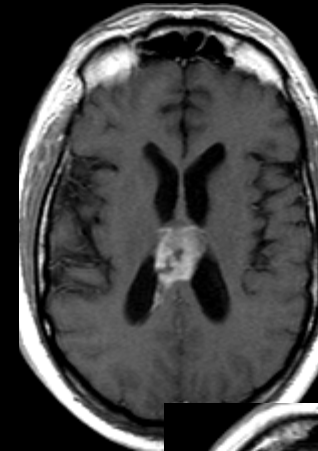
The scoring is not applicable if there is no contrast enhancement. If most of the enhancing rim
Is thin, regular, and measures < 3 mm in thickness and has homogenous enhancement the grade is **thin**. If most of the rim demonstrates nodular and/or thick enhancement, the grade is **thick**. If there is only solid enhancement and no rim, the grade is **solid**.

f12 – Definition of the enhancing margin
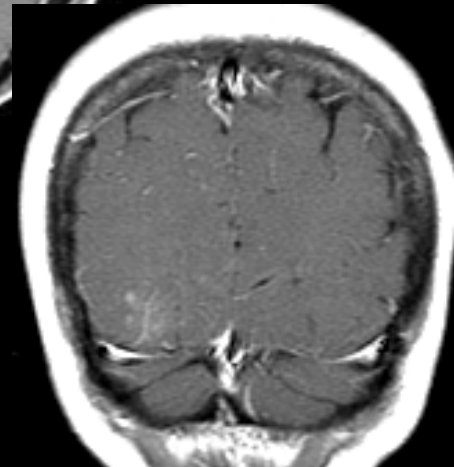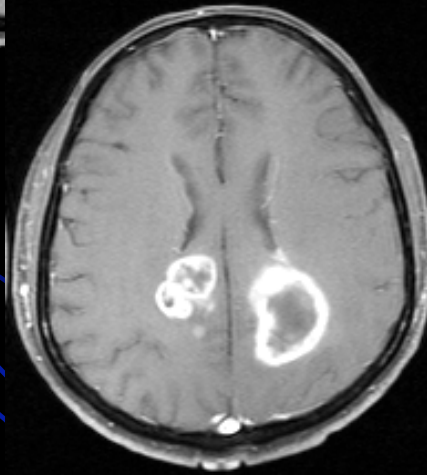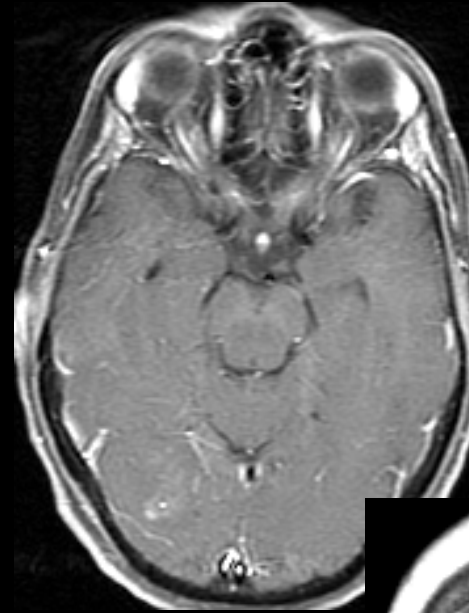
(2) Well-defined

(3) Poorly-defined

The scoring is not applicable (n/a) if there is no contrast enhancement. Assess if most of the outside margin of the enhancement is well defined or poorly defined. Are you able to easily trace the margin of enhancement?

f13 – Definition of the non-enhancing margin (e.g. Grade III)
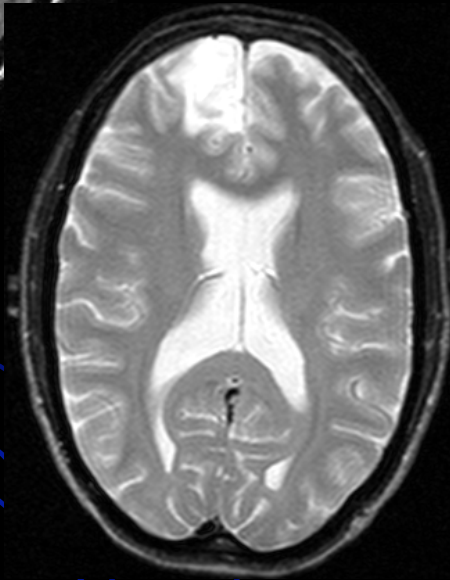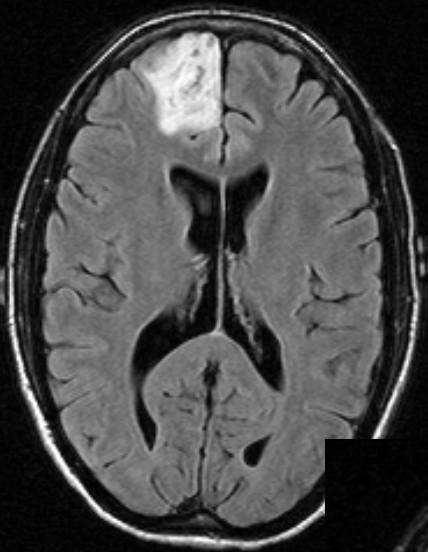
(2) Well-defined
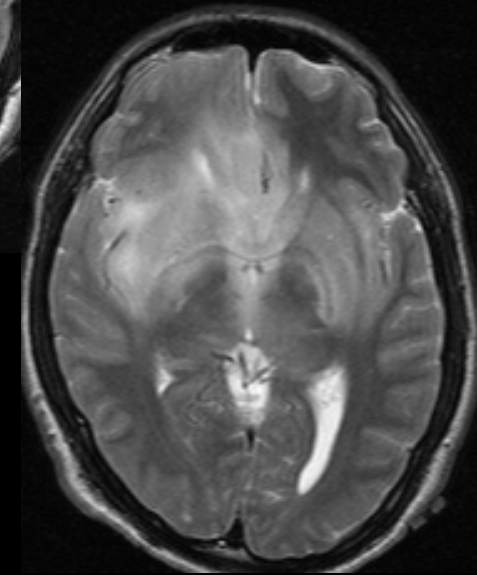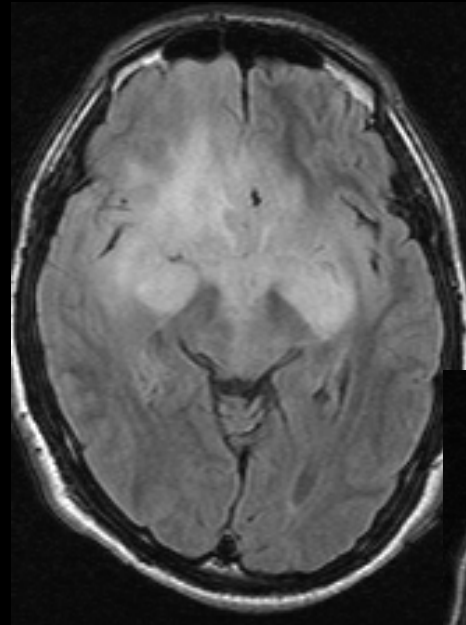
(3) Poorly-defined

If most of the outside non-enhancing margin of the tumor is well defined and smooth (geographic), versus if the margin is ill-defined and irregular.

f14 – Proportion of Edema
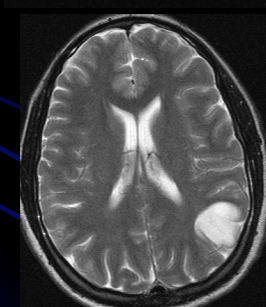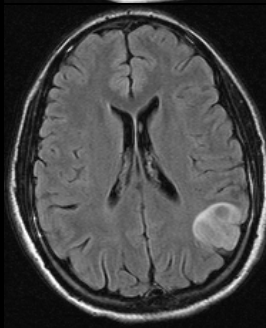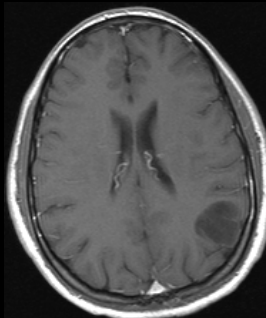
(2) None 0%   (3) < 5%   (4) 6-33%   (5) 34-67%
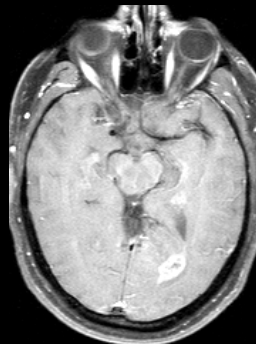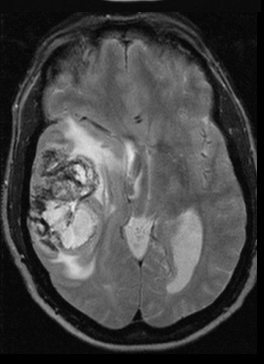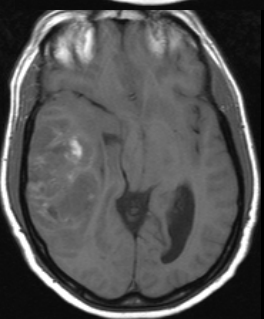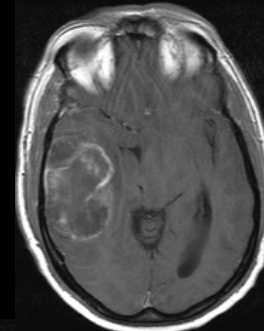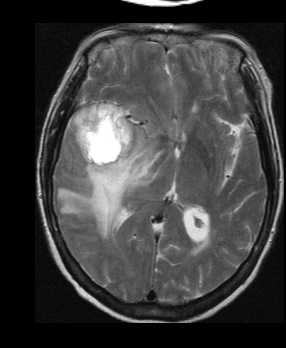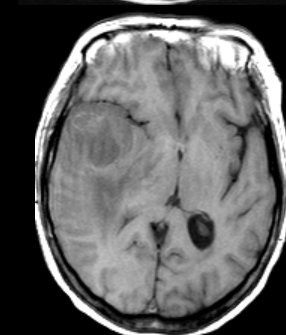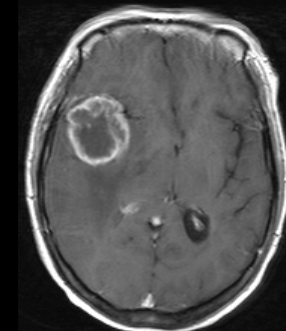
Visually, when scanning through the entire tumor volume, what proportion of the entire abnormality is estimated to represent vasogenic edema? (Edema should be greater in signal than than nCET and somewhat lower in signal than CSF. Pseudopods are characteristic of edema). (Assuming that the the entire abnormality may be comprised of: (1) an enhancing component, (2) a non-enhancing component, (3) a necrotic component and (4) a edema component.)

f16 – Hemorrhage
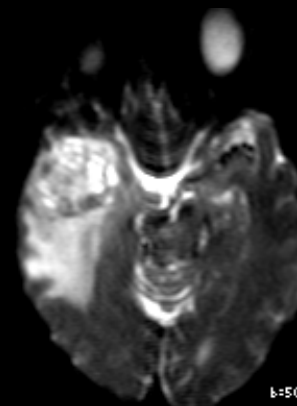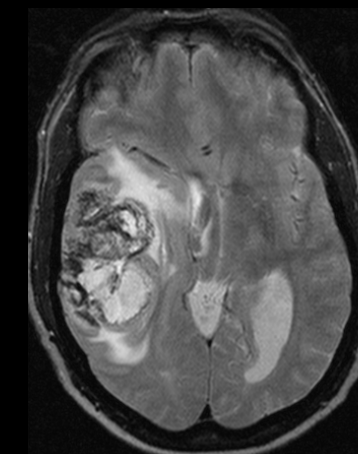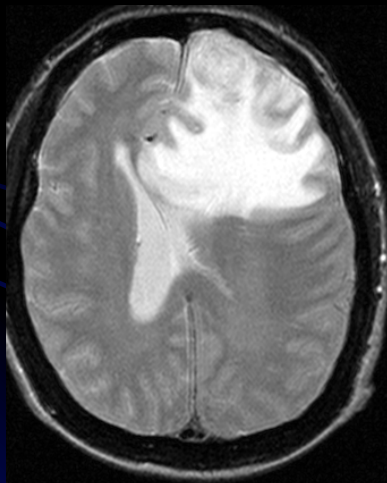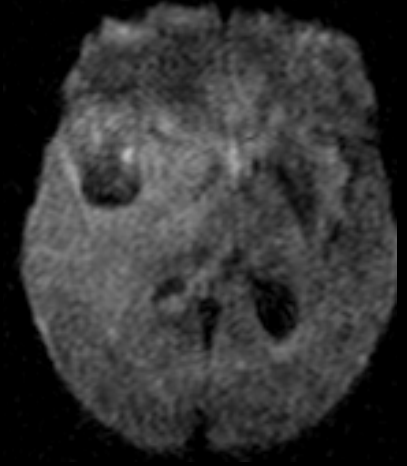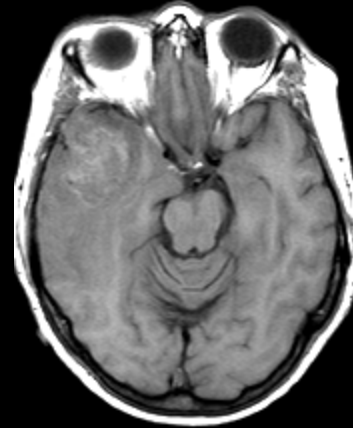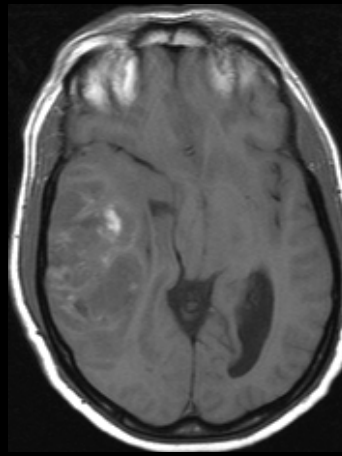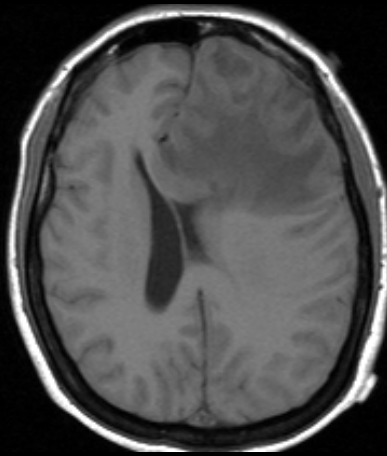
(1) No

(2) Yes

Intrinsic hemorrhage in the tumor matrix. Any intrinsic foci of low signal on T2WI or high signal on T1WI. (Use Bo image if necessary for confirmation.)

f17 – Diffusion Characteristics
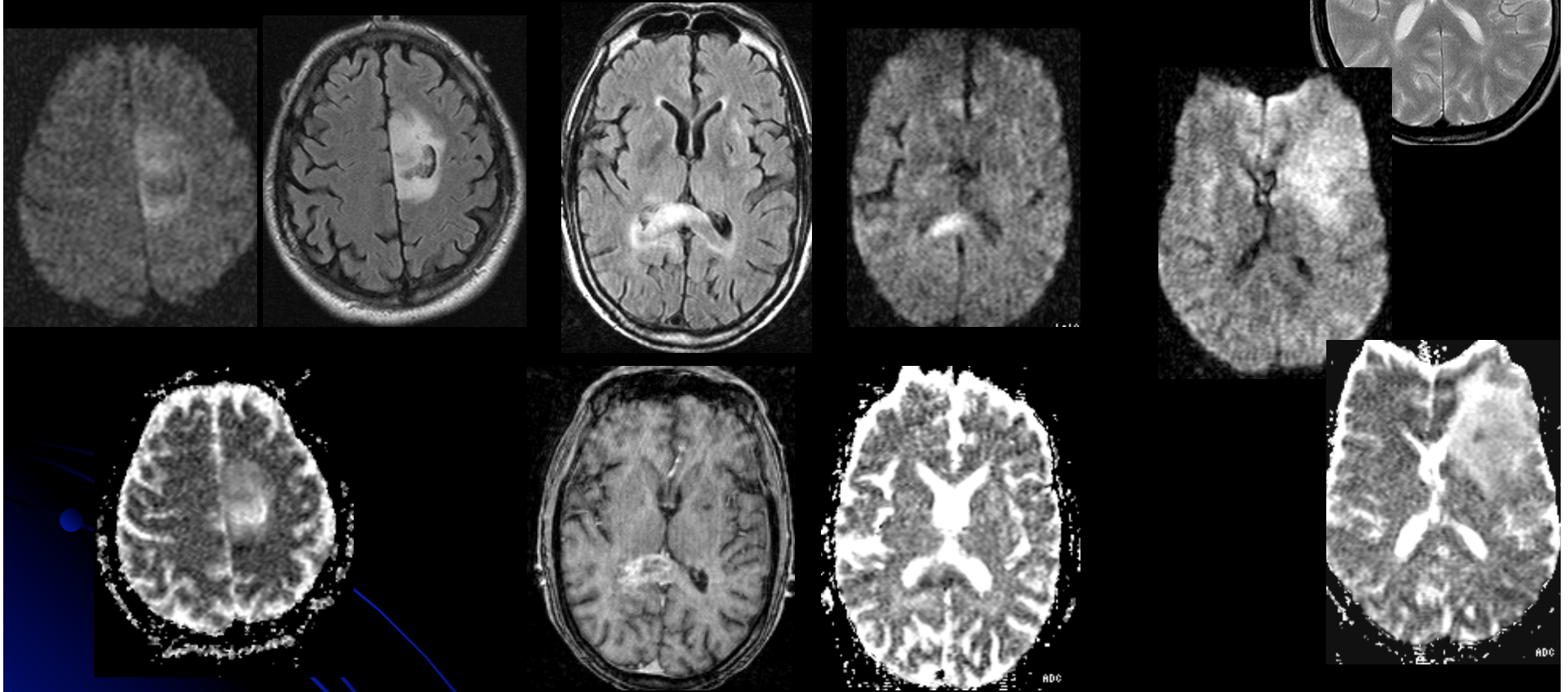
(2) Facilitated

(3) Restricted

Mixed

Predominantly *facilitated* or *restricted* diffusion in the enhancing or nCET portion of the tumor. (Based on ADC map). [Rate CET alone when present, otherwise use nCET]. *Indeterminate* = unsure. *Mixed* = relatively equal proportion of facilitated and restricted. No ADC maps = use no-images. Proportion of tissue not relevant.

f18 – Pial Invasion
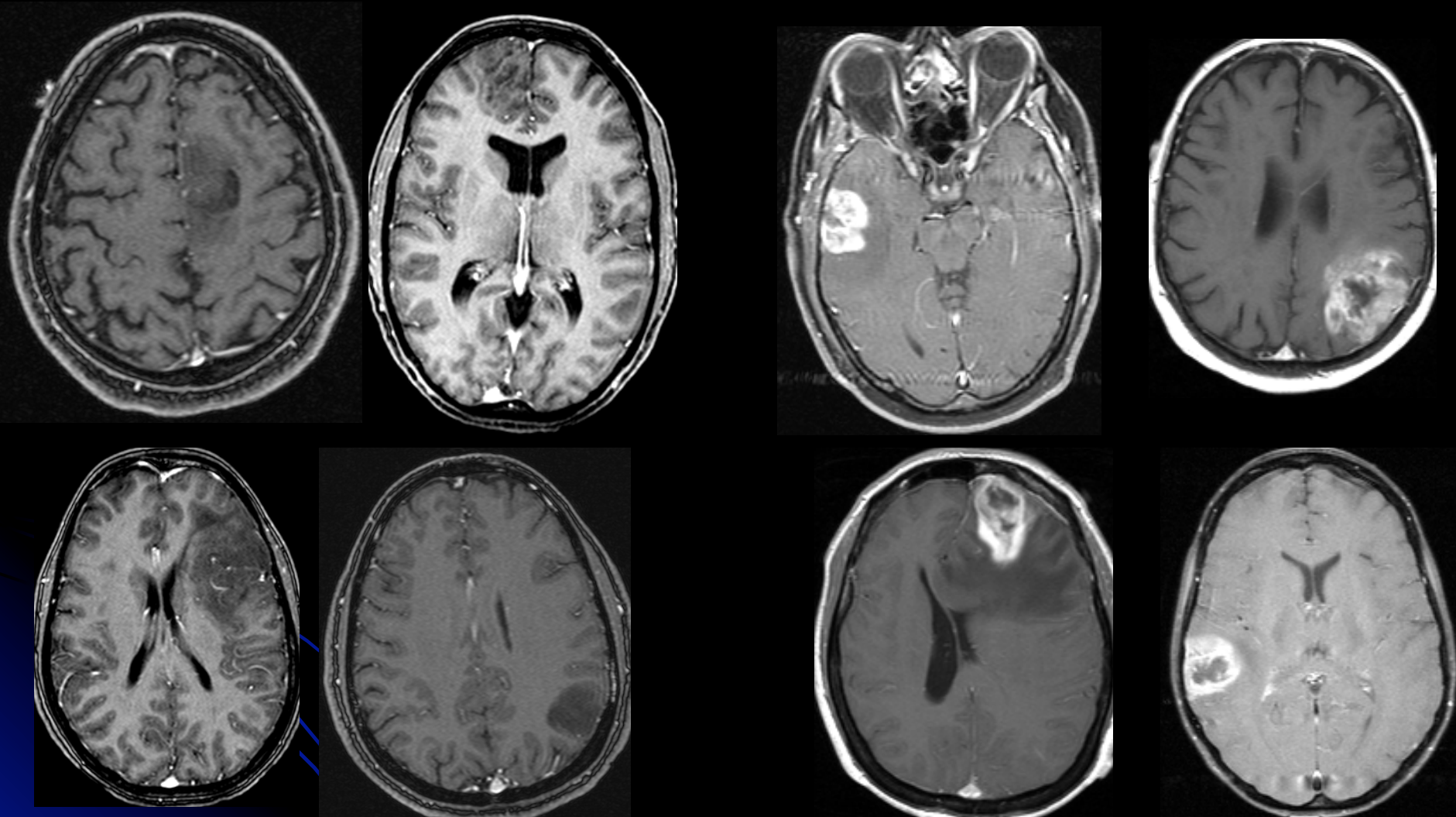
(1) No   (2) Yes

Enhancement of the overlying pia in continuity with enhancing or non-enhancing tumor
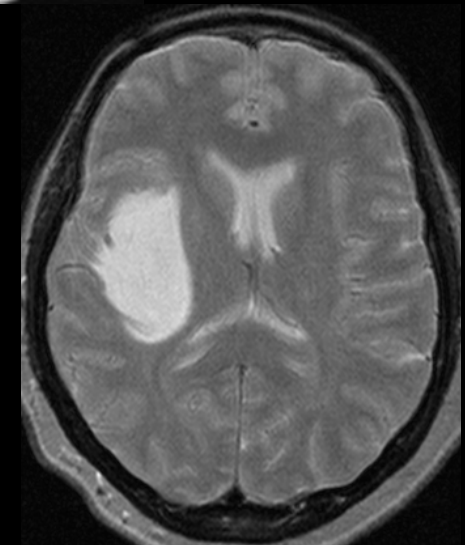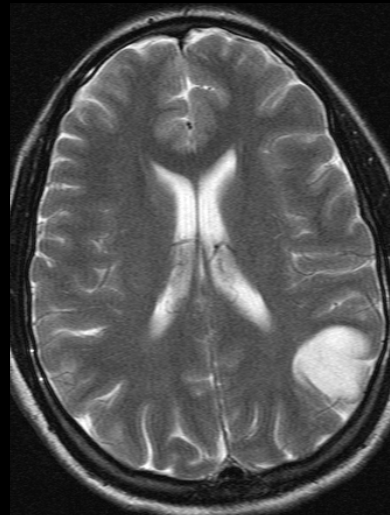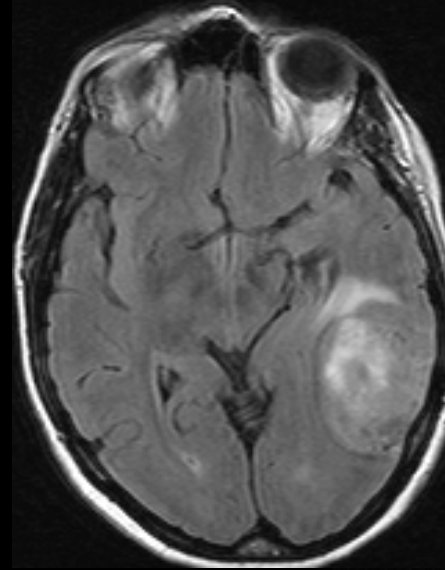
f19 – Ependymal Extension
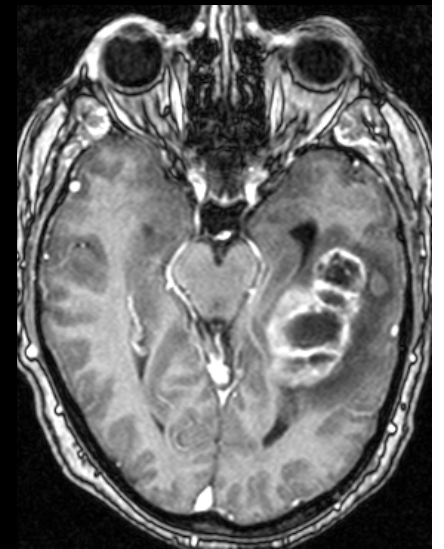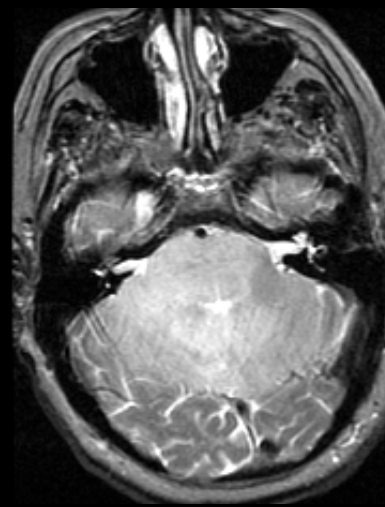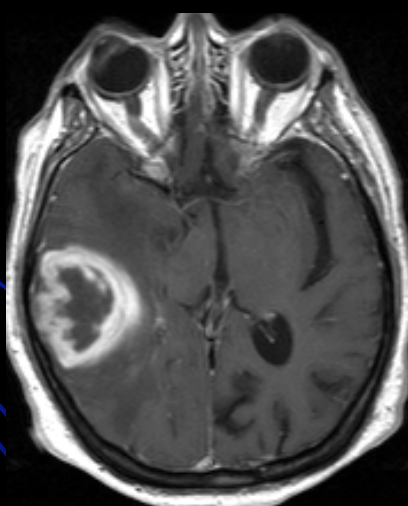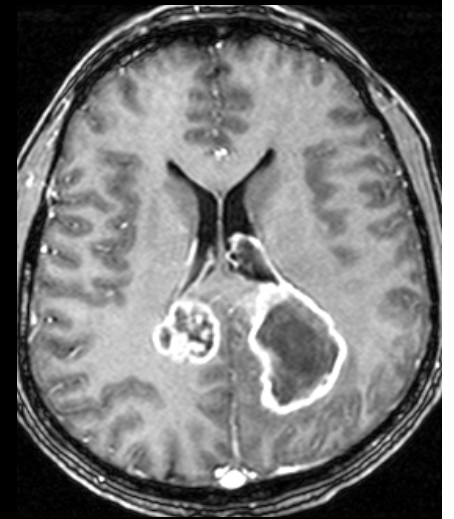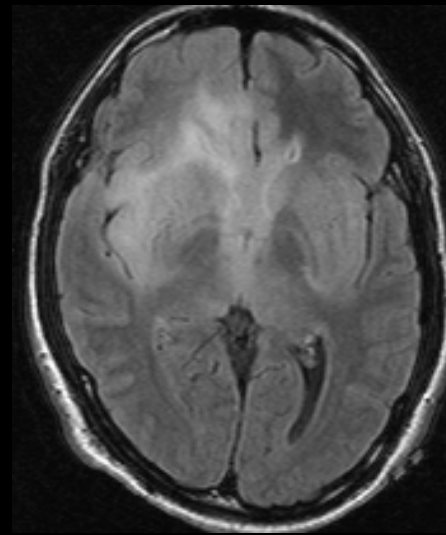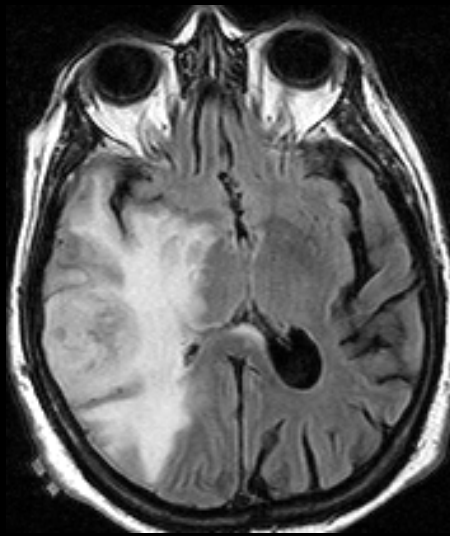
(1) No

(2) Yes

Invasion of any adjacent ependymal surface in continuity with enhancing or non-enhancing tumor matrix.
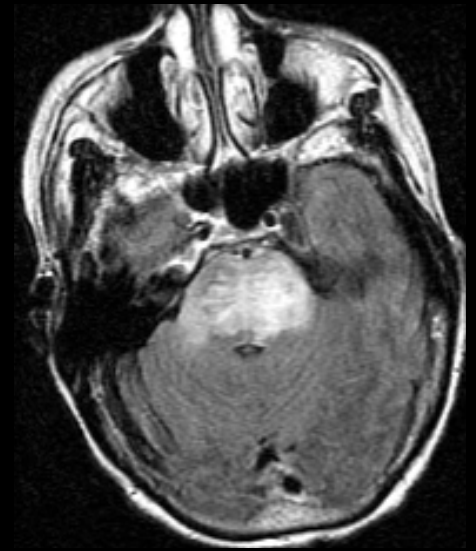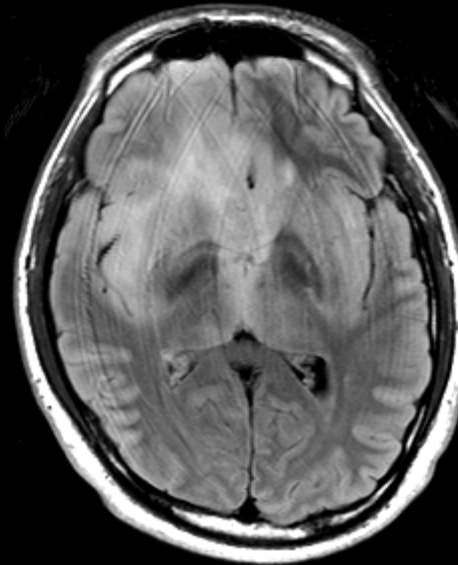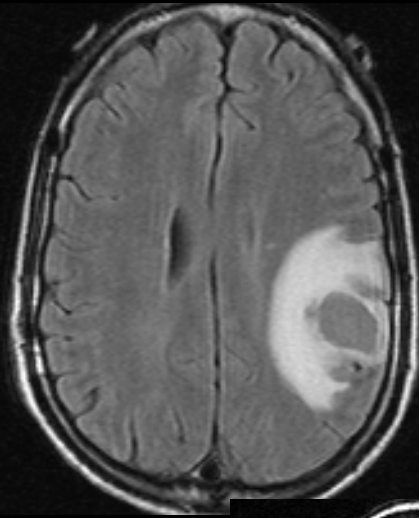
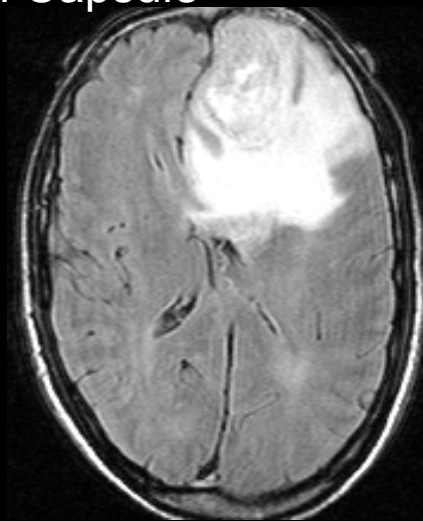# f20 – Cortical Involvement
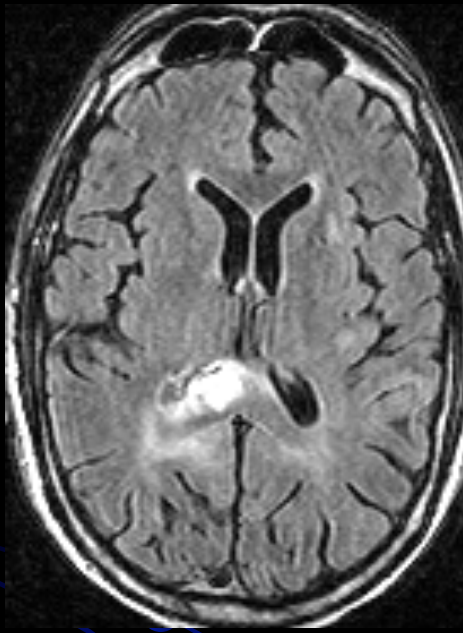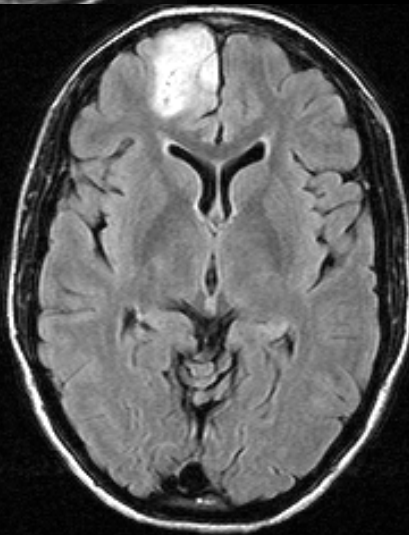

(1) No

(2) Yes

Non-enhancing or enhancing tumor extending to the cortical mantle, or cortex is no longer distinguishable relative to subjacent tumor.

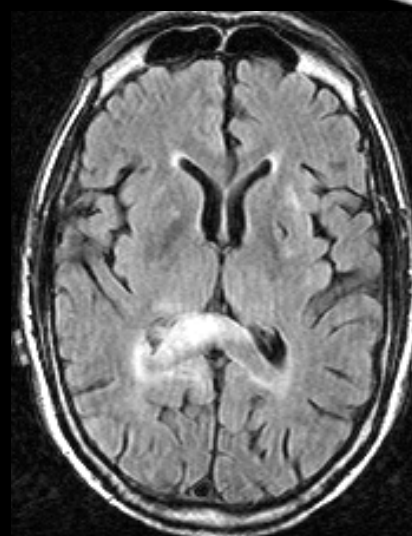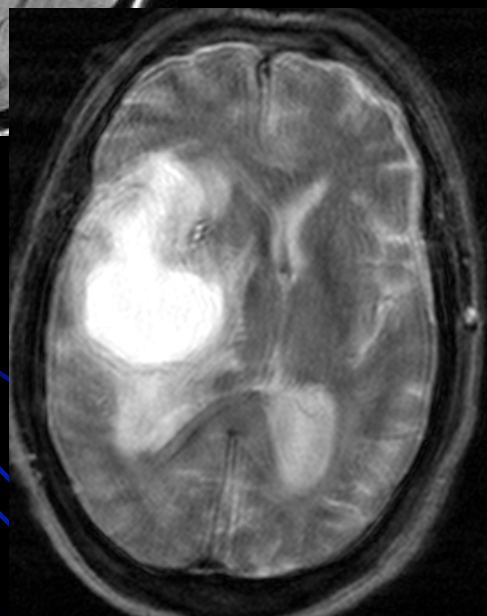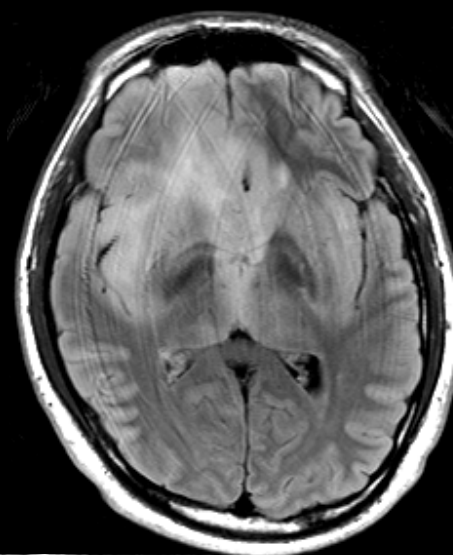# f21 – Deep White Matter Invasion
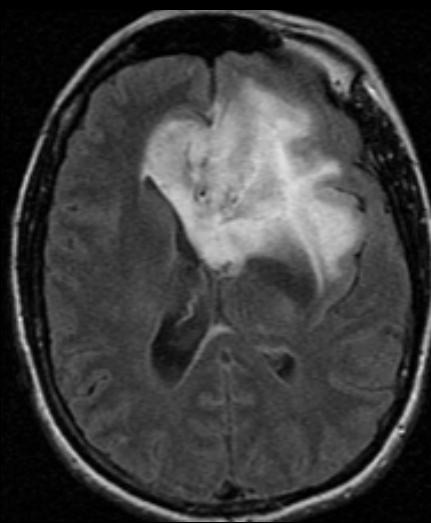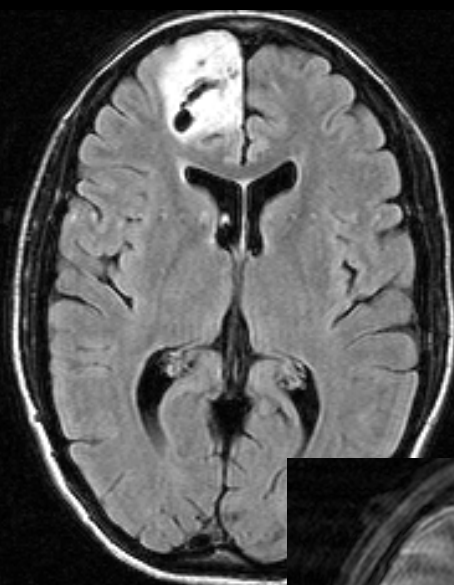

Internal Capsule

Brainstem

Corpus Callosum

(1) No

Enhancing or nCET tumor extending into the internal capsule, corpus callosum or brainstem.
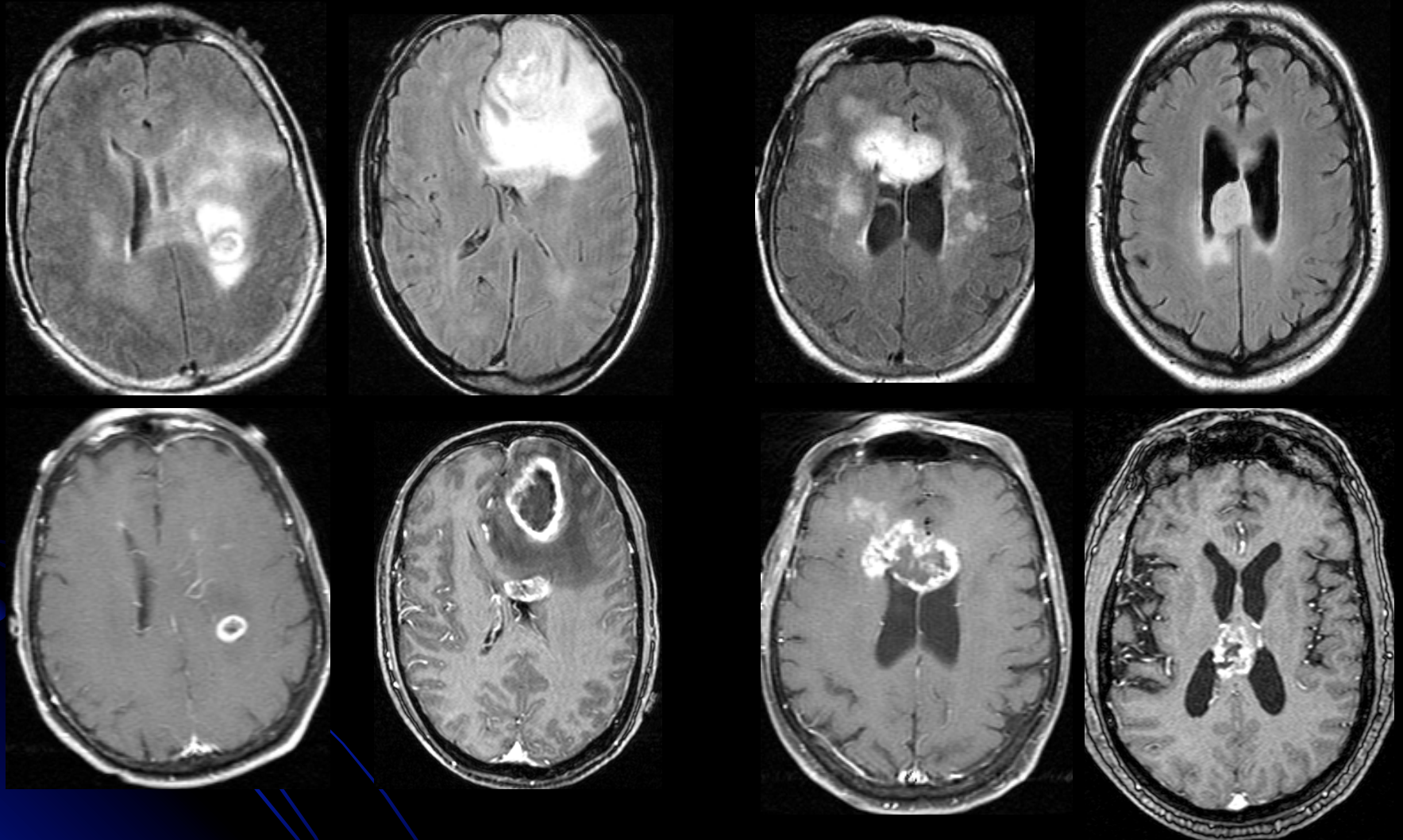
f22 – nCET Crosses Midline

(2) No

(3) Yes

nCET crosses into contralateral hemisphere through white matter commissures (exclusive of herniated ipsilateral tissue).
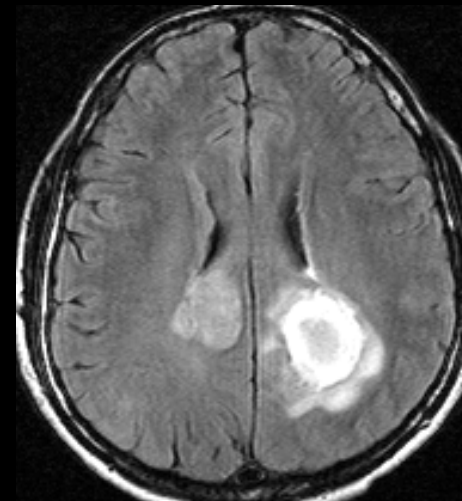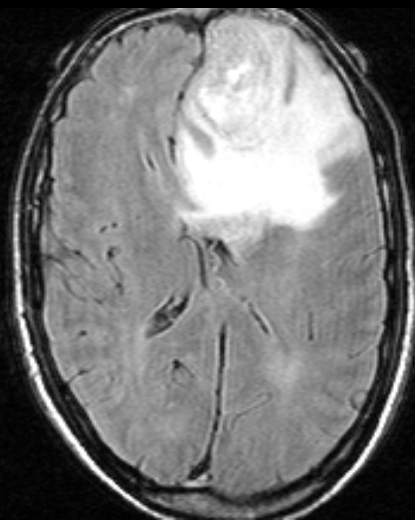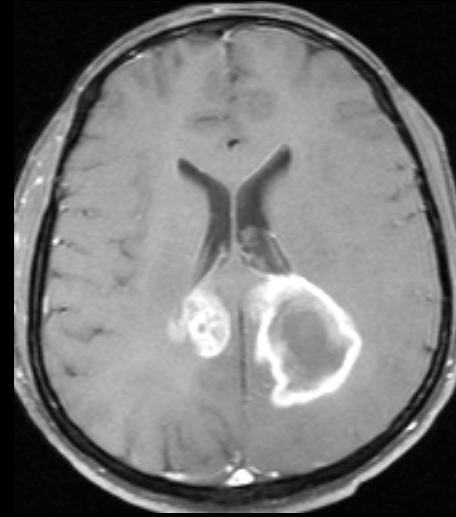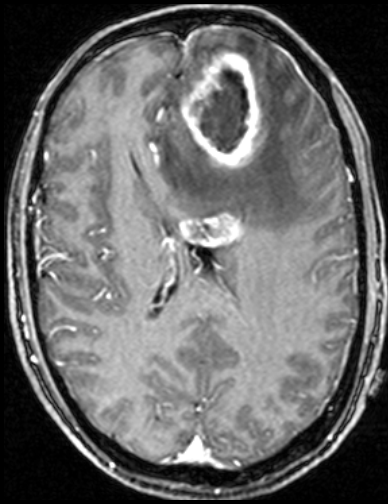
f23 – CET Crosses Midline

(2) No

(3) Yes

Enhancing tissue crosses into contralateral hemisphere through white matter commisures (exclusive of herniated ipsilateral tissue).
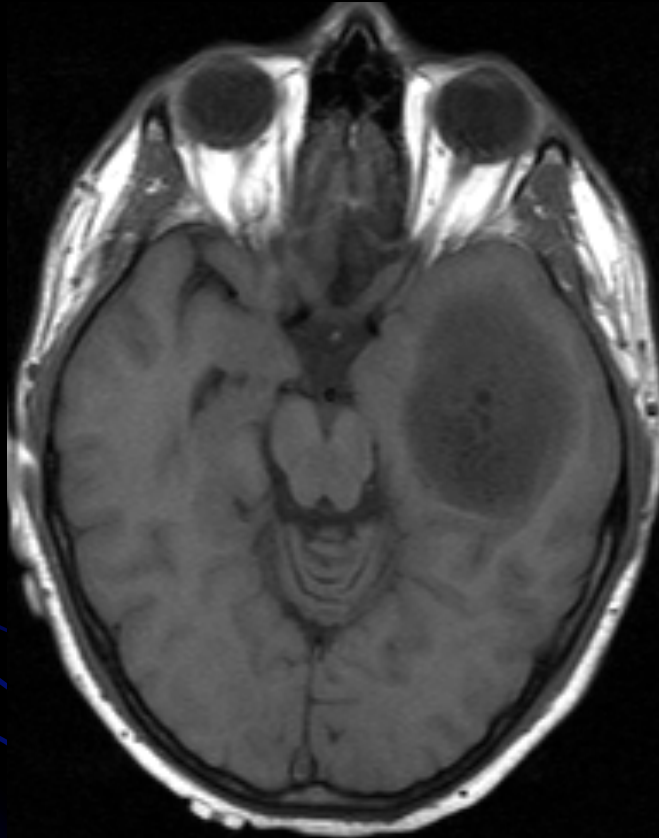
f24 – Satellites

(2) Yes

A satellite lesion is an area of enhancement within the region of signal abnormality surrounding the dominant lesion but not contiguous in any part with the major tumor mass.

f25 – Calvarial Remodeling

(2) Yes?

Erosion of inner table of skull (possibly a secondary sign of slow growth)

Questions/suggestions?

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