



Dr Ross Keenan

Neuroradiologist

Christchurch Hospital

Managing Strokes in 2013 - Concurrent Workshop Repeated

Friday, 16 August 2013

Start 4:30pm

Start 5:35pm

Duration: 55mins

Duration: 55mins

Da Vinci

Da Vinci



South GP CME 2013

General Practice Conference & Medical Exhibition

15-18 August | Edgar Centre | Dunedin

Stroke Imaging

Dr Ross Keenan

Consultant Adult & Paediatric Neuroradiologist

GP CPD Conference, 15-18 August 2013

Workshop, Friday 4.30 - 6.30pm 16 August 2013

Edgar Centre Dunedin

Stroke Imaging 2013

Dr Ross Keenan, Neuroradiologist

Disclosures:

Christchurch Hospital (CDHB)

Christchurch Radiology Group (CRG)

NZ Brain Research Institute (NZBRI, VdV)

Stroke

Definition:

- generic clinical definition:
- “**clinical** event with sudden onset neurologic deficit > 24 hrs”
- “stroke” is **not** an imaging diagnosis

“not all strokes are the same” !!

Stroke

Thrombolysis Evidence Base

IST3 – International Stroke Trial – 3 (2013)

Conclusion

“IST-3 provides evidence that thrombolysis with iv alteplase (rtPA) for acute ischemic stroke does not affect survival, but does lead to statistically significant, clinically relevant improvements in functional outcome and health related quality of life (QOL) that are sustained for at least 18 months”

Reference: IST-3 Lancet Neurol 2013; 12: 768 -776

Stroke

Guidelines 1

AHA/ASA Guidelines in Acute Ischemic Stroke

Stroke 2013

Stroke

Action	Time
Door to physician	≤ 10 minutes
Door to stroke team	≤ 15 minutes
Door to CT initiation	≤ 25 minutes
Door to CT interpretation	≤ 45 minutes
Door to drug (≥ 80% compliance)	≤ 60 minutes
Door to stroke unit admission	≤ 3 hours

“time is brain”

Stroke

National Institutes of Health Stroke Scale (NIHSS)

1A	Level of consciousness	0-Alert, 1-Drowsy, 2-Obtunded, 3-Coma/unresponsive
1B	Orientation questions (2)	0-Answers both correctly, 1-Answers 1 correctly, 2-Answers neither correctly
1C	Response to commands (2)	0-Performs both tasks correctly, 1-Performs 1 task correctly, 2-Performs neither
2	Gaze	0-Normal horizontal movements, 1-Partial gaze palsy, 2-Complete gaze palsy
3	Visual fields	0-No visual field defect, 1-Partial hemianopia, 2-Complete hemianopia, 3-Bilateral hemianopia
4	Facial movement	0-Normal, 1-Minor facial weakness, 2-Partial facial weakness, 3-Complete unilateral palsy
5	Motor function (arm) a. Left b. Right	0-No drift, 1-Drift before 5 seconds, 2 -Falls before 10 seconds, 3-No effort against gravity, 4-No movement
6	Motor function (leg) a. Left b. Right	0-No drift, 1-Drift before 5 seconds, 2-Falls before 5 seconds, 3-No effort against gravity, 4-No movement
7	Limb ataxia	0-No ataxia, 1-Ataxia in 1 limb, 2-Ataxia in 2 limbs
8	Sensory	0-No sensory loss, 1-Mild sensory loss, 2-Severe sensory loss
9	Language	0-Normal, 1-Mild aphasia, 2-Severe aphasia, 3-Mute or global aphasia
10	Articulation	0-Normal, 1-Mild dysarthria, 2-Severe dysarthria
11	Extinction or inattention	0-Absent, 1-Mild (loss 1 sensory modality lost), 2-Severe (loss 2 modalities lost)

Stroke

Immediate Evaluation in Suspected Acute Ischemic Stroke

All patients

Brain imaging - **non contrast CT or MRI**

Blood glucose

O₂ saturation

Serum electrolytes/renal function tests*

Full blood count, including platelet count*

Markers of cardiac ischemia*

Stroke

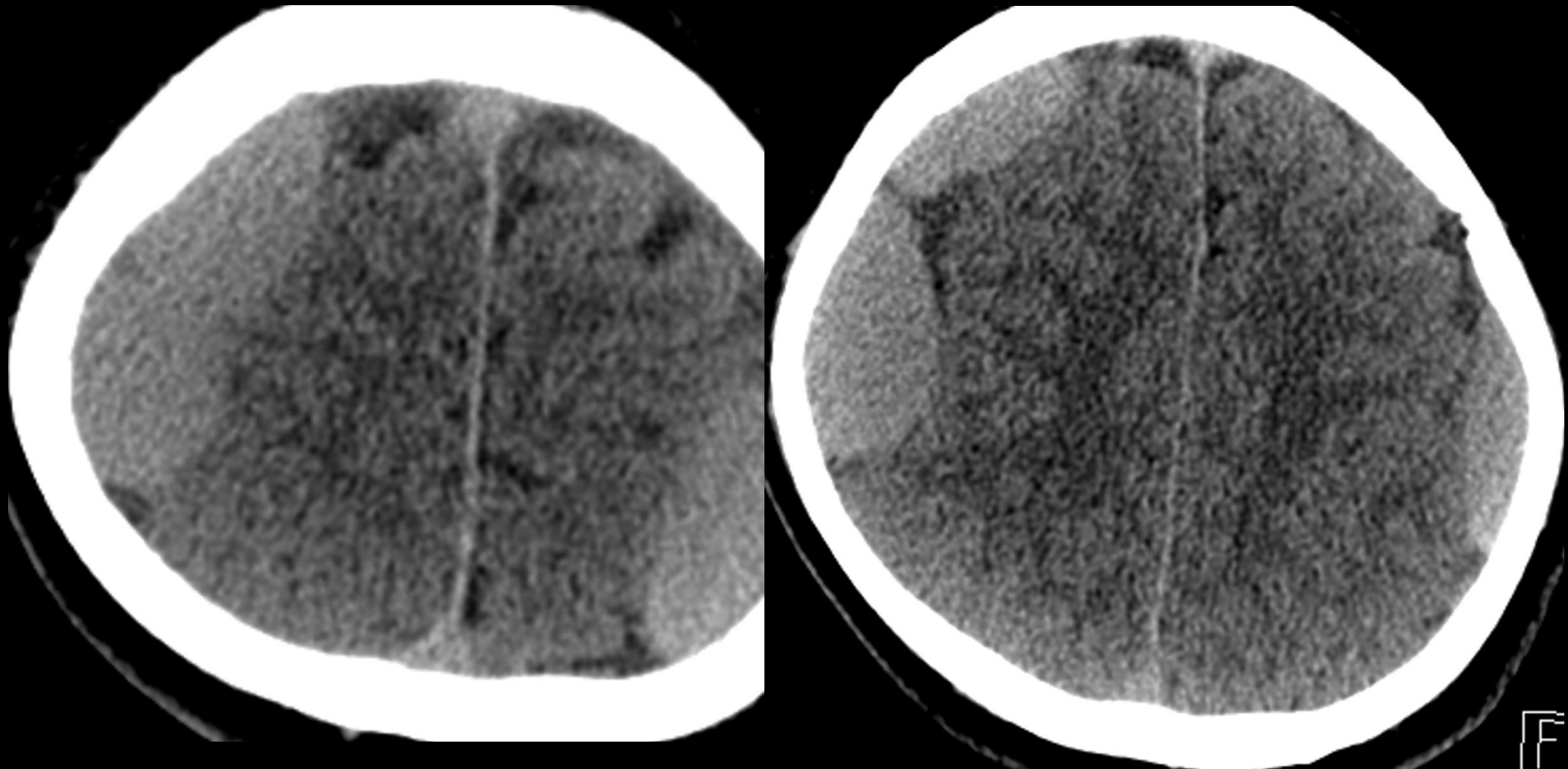
Stroke mimicks

Stroke Imaging

“stroke mimicks”

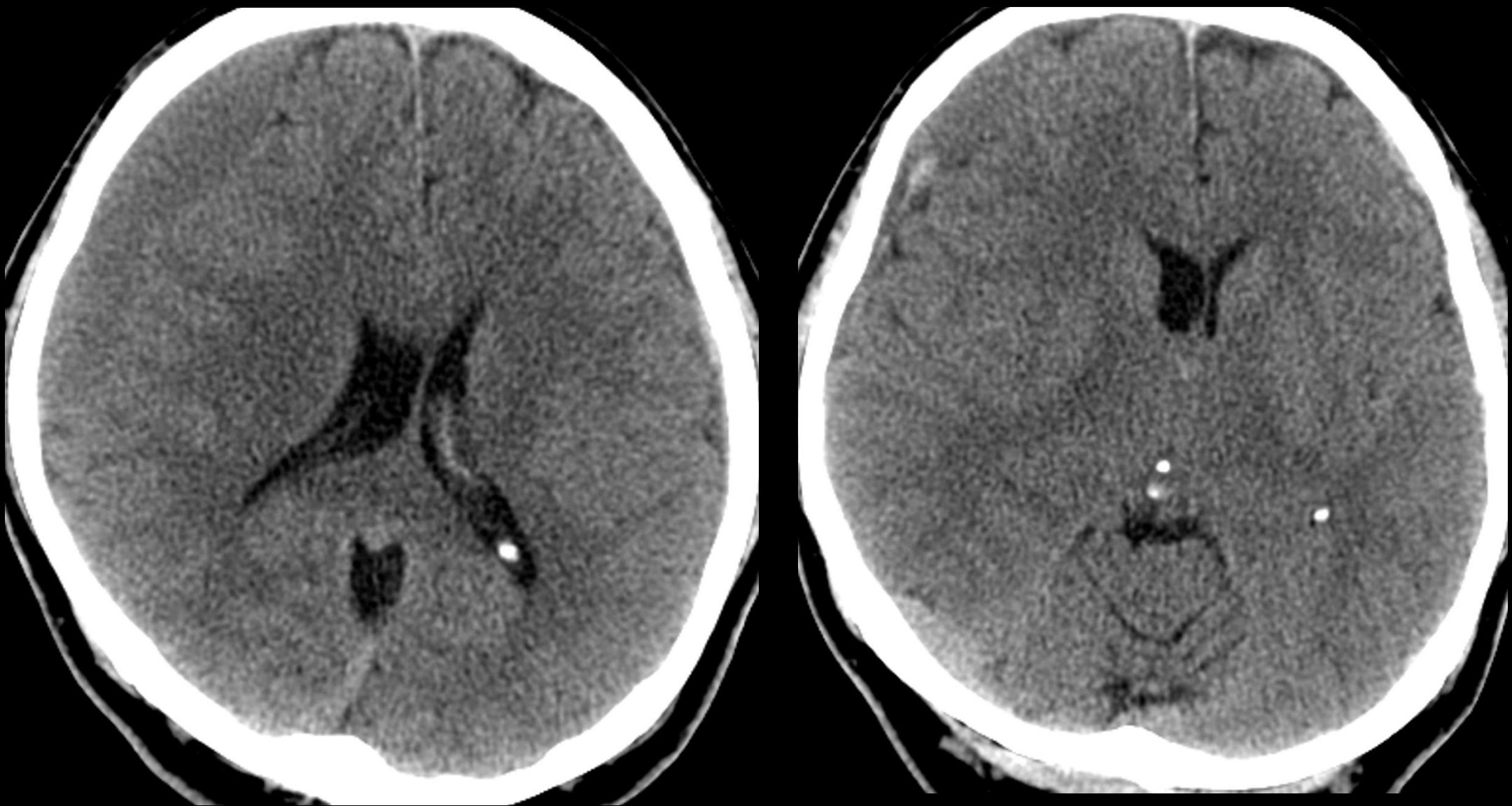
is the stroke an acute ischemic infarct?

Stroke mimicks



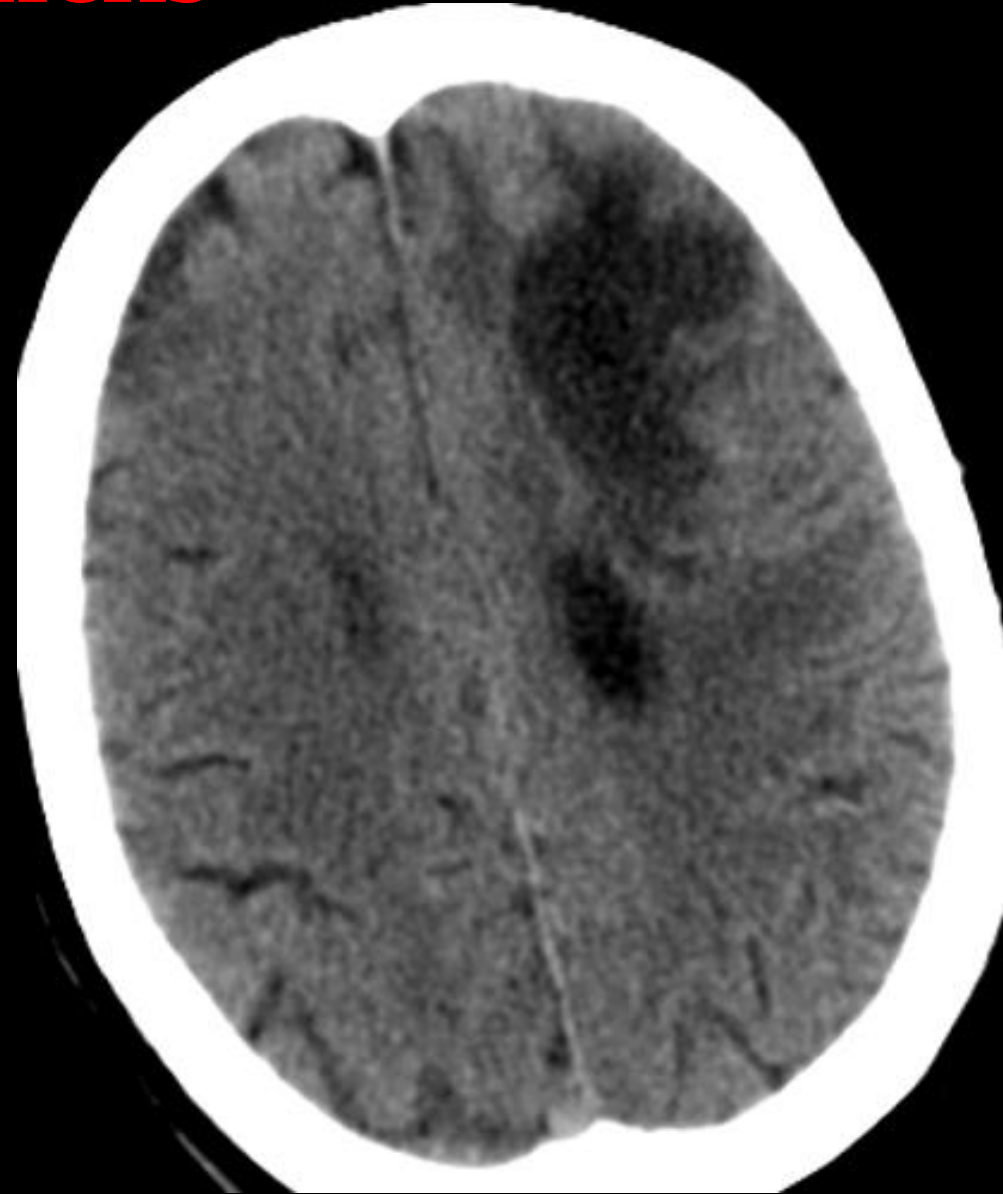
M61yr R hemiparesis, CT R > L bilateral spontaneous SDH

Stroke mimicks



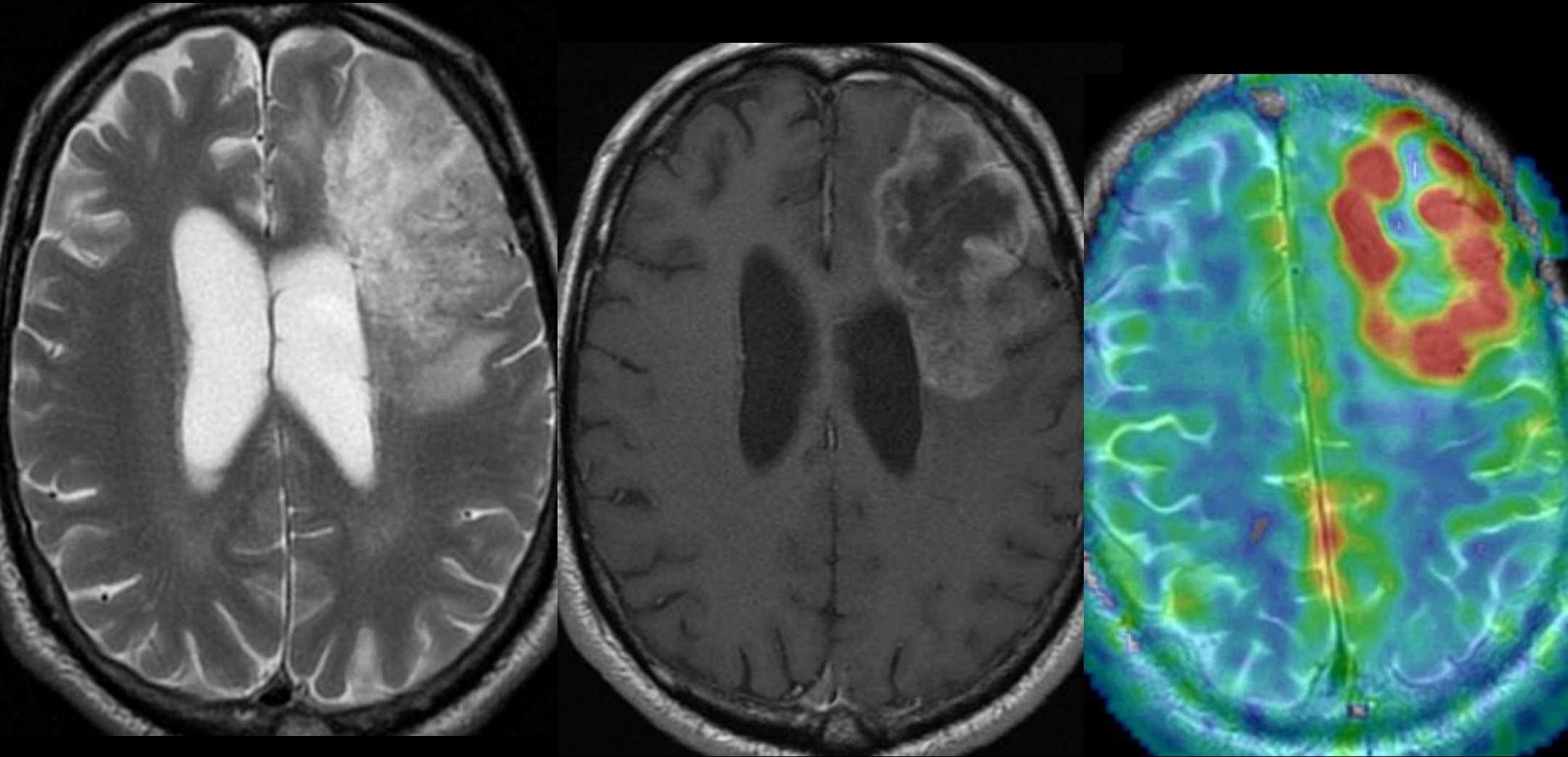
M61yr R hemiplegia, 2 week F/U isodense CT SDH, conservative Rx

Stroke mimicks



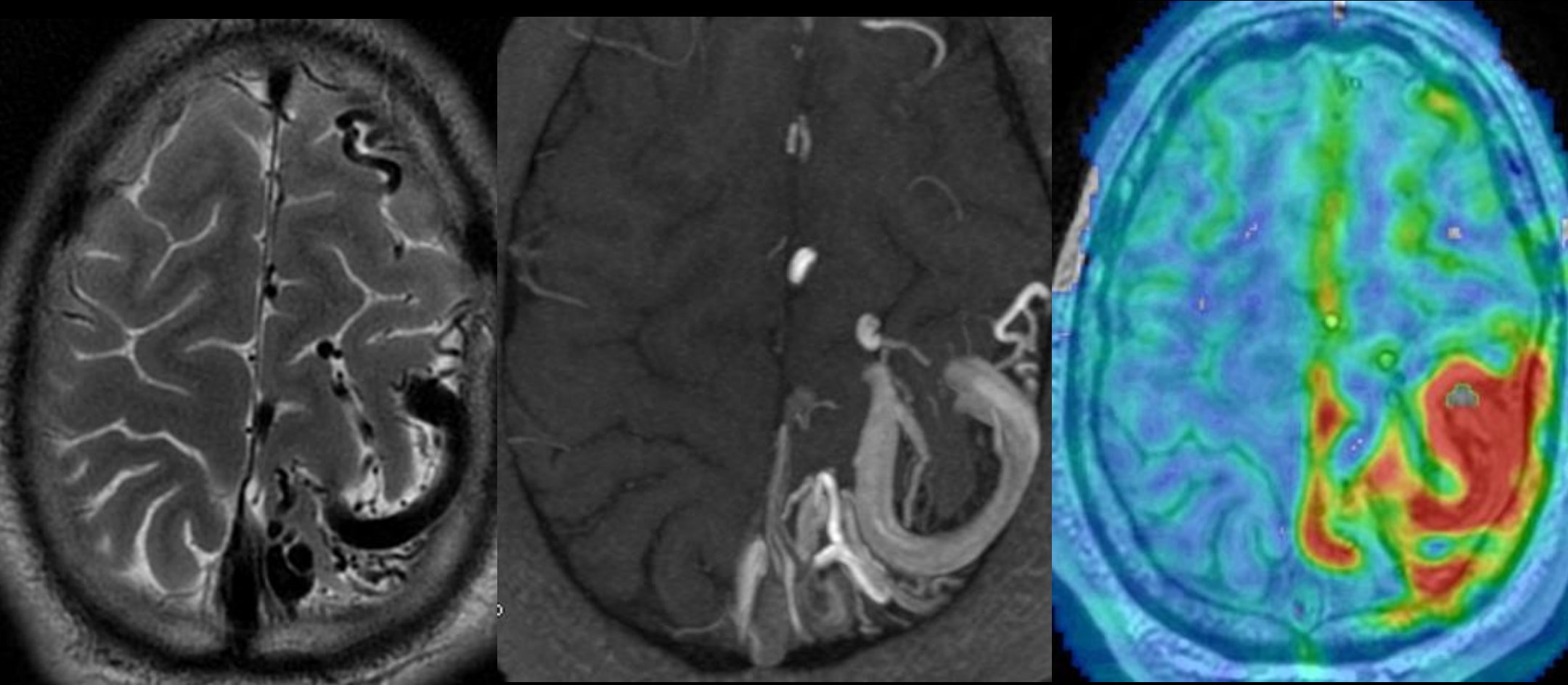
M76yr dysphasia +/- behavioural Δ , diagnostic CT 1

Stroke mimicks



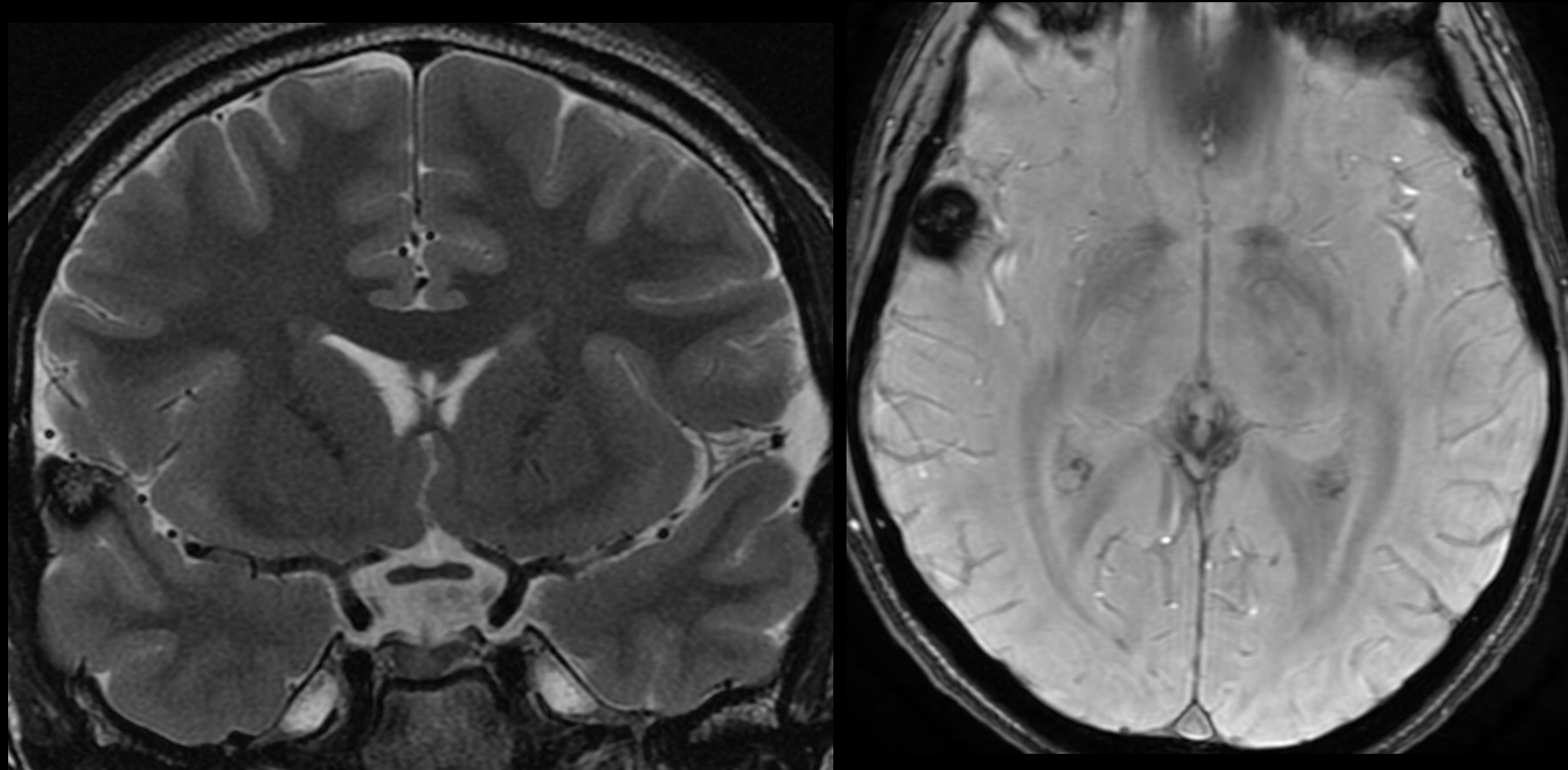
M76yr dysphasia +/- behavioural Δ , F/U MRI day 44

Stroke mimicks



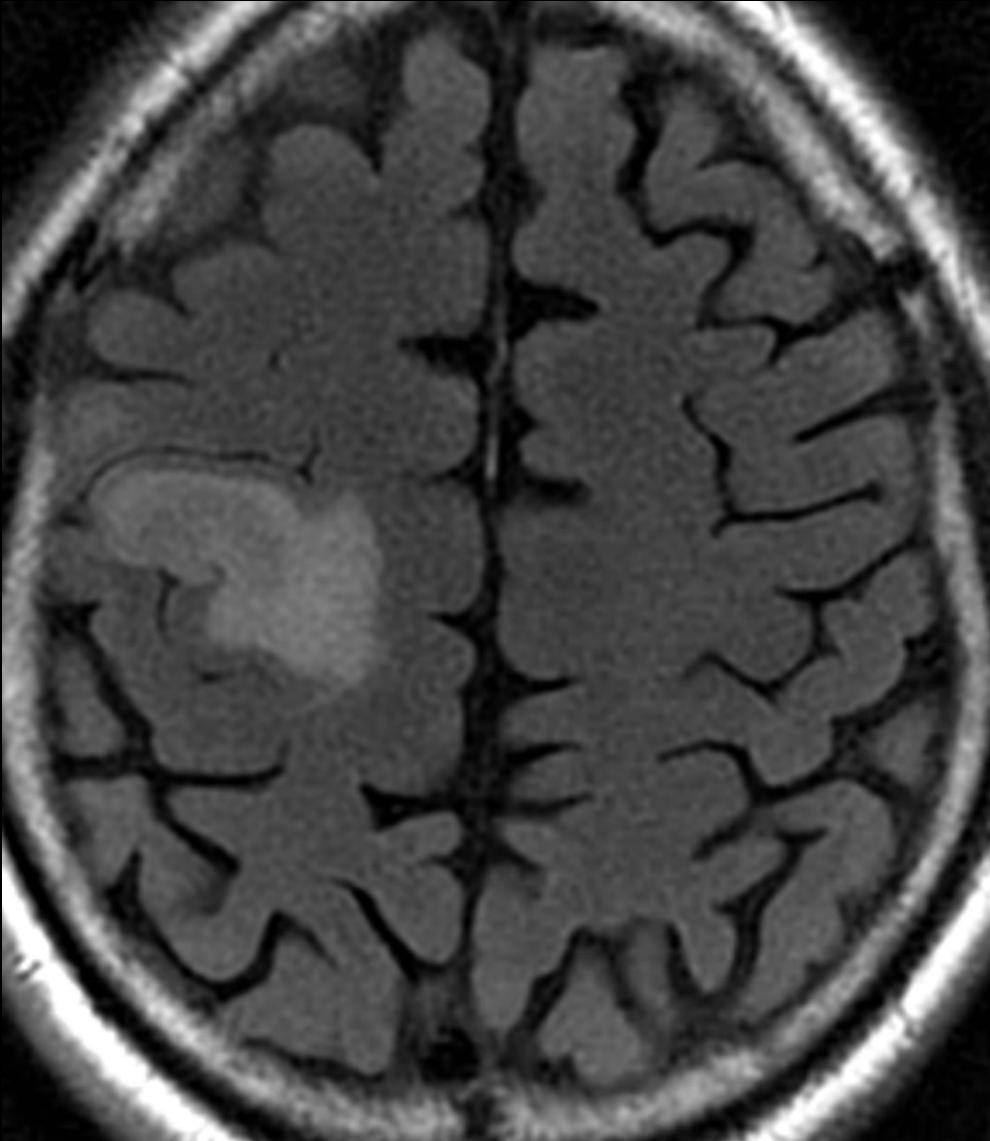
M33yr acute R hemiplegia, MRI

Stroke mimicks



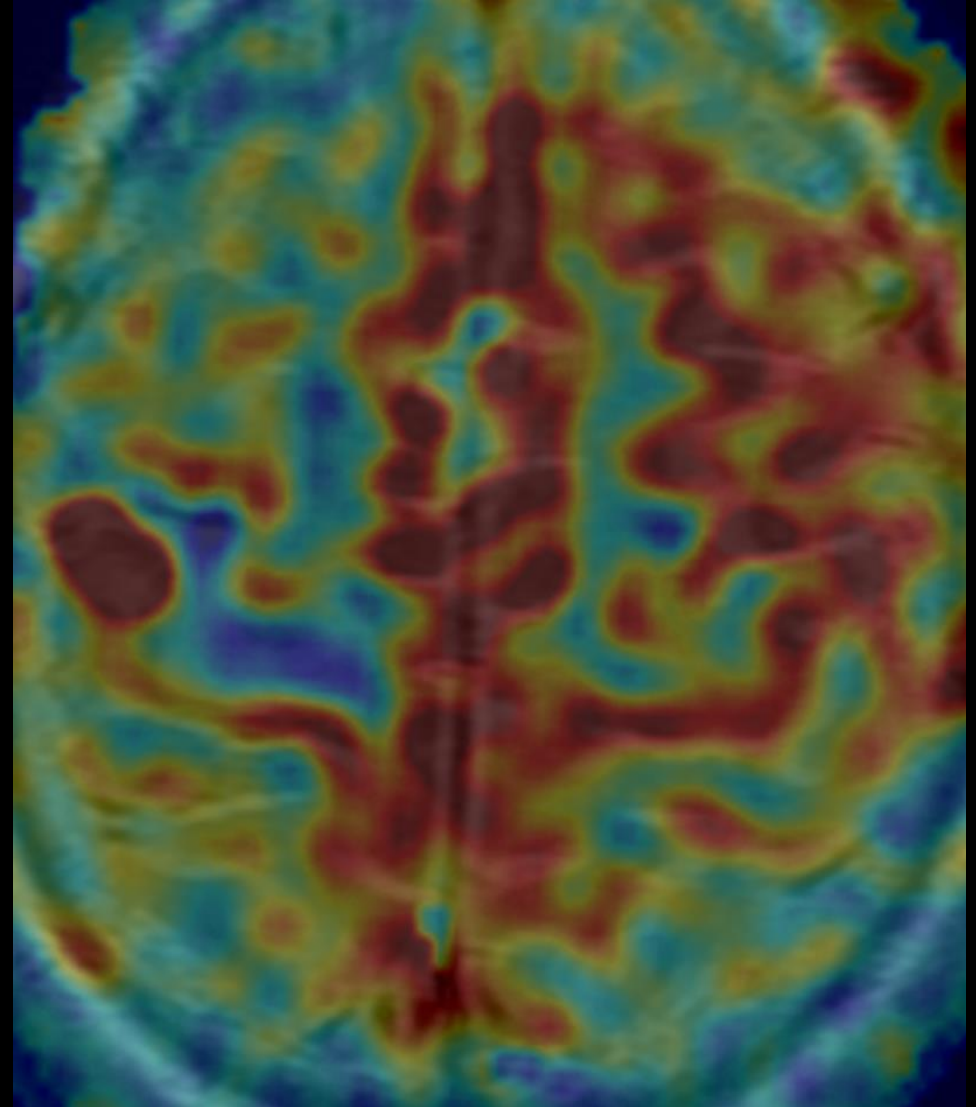
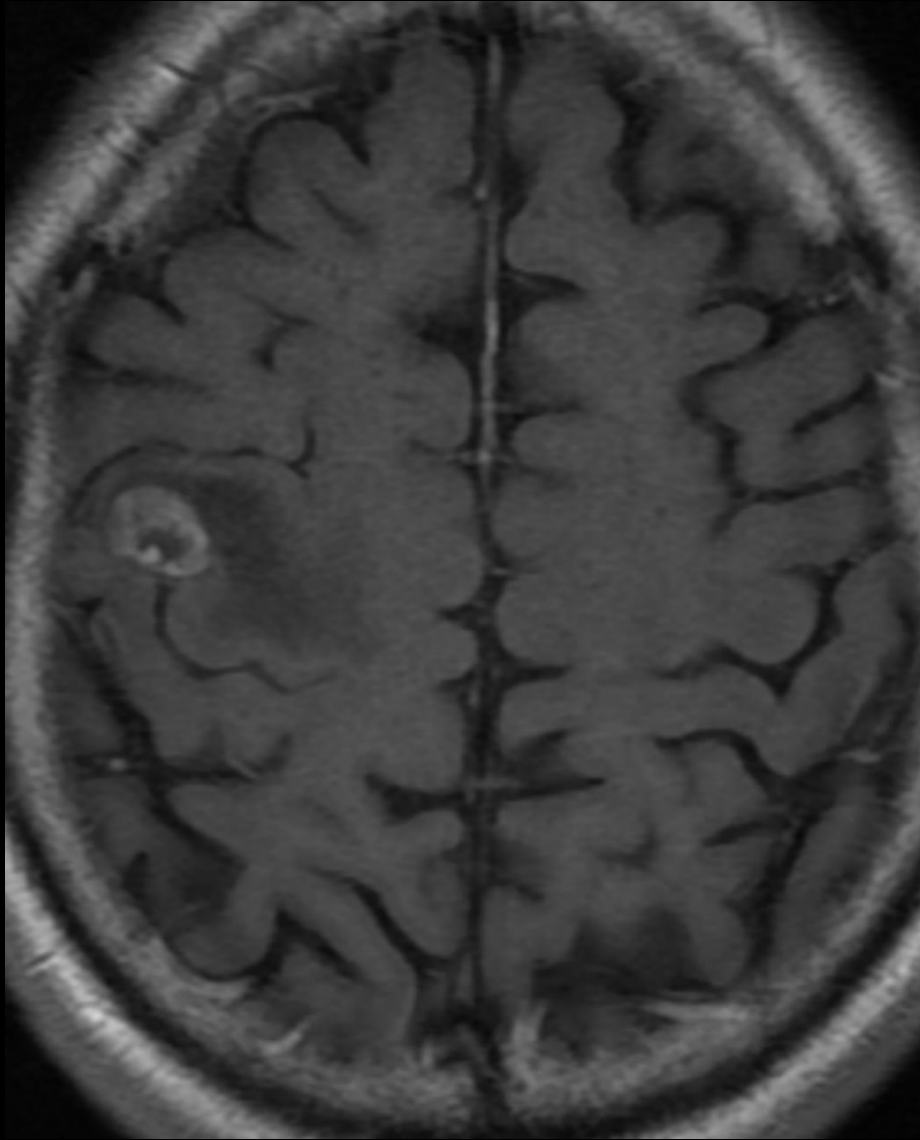
M19yr acute stroke-like episode, MRI 1

Stroke mimicks



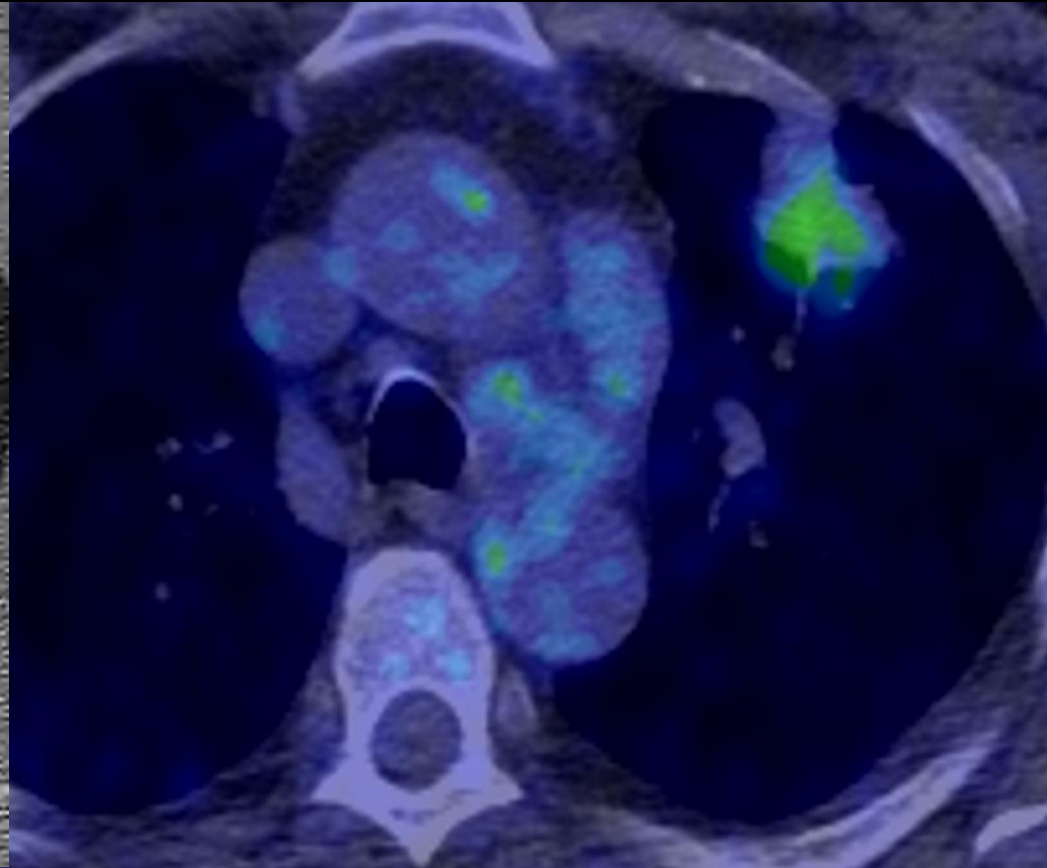
M52yr L hemiplegia ? acute episode, MRI 1

Stroke mimicks



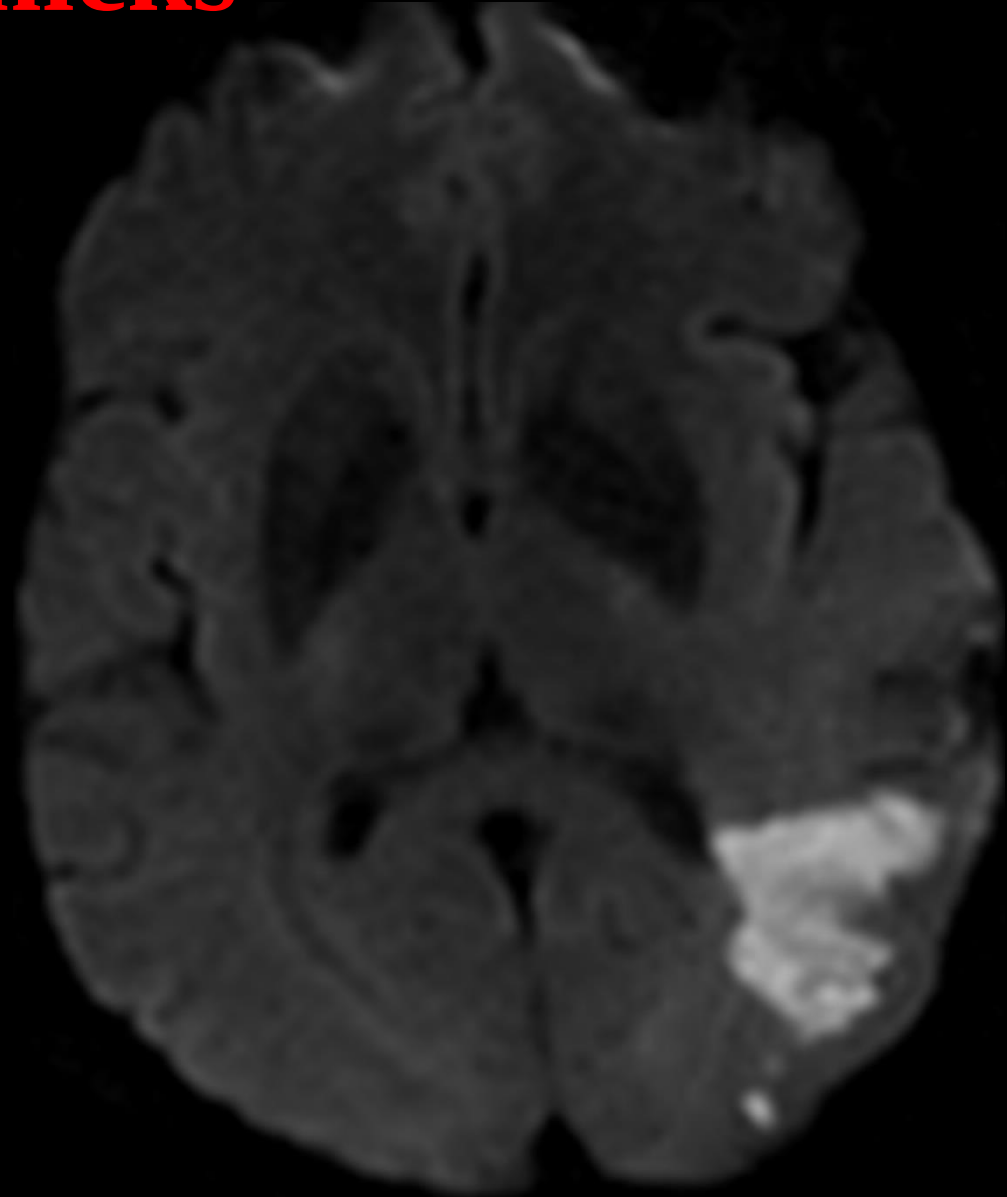
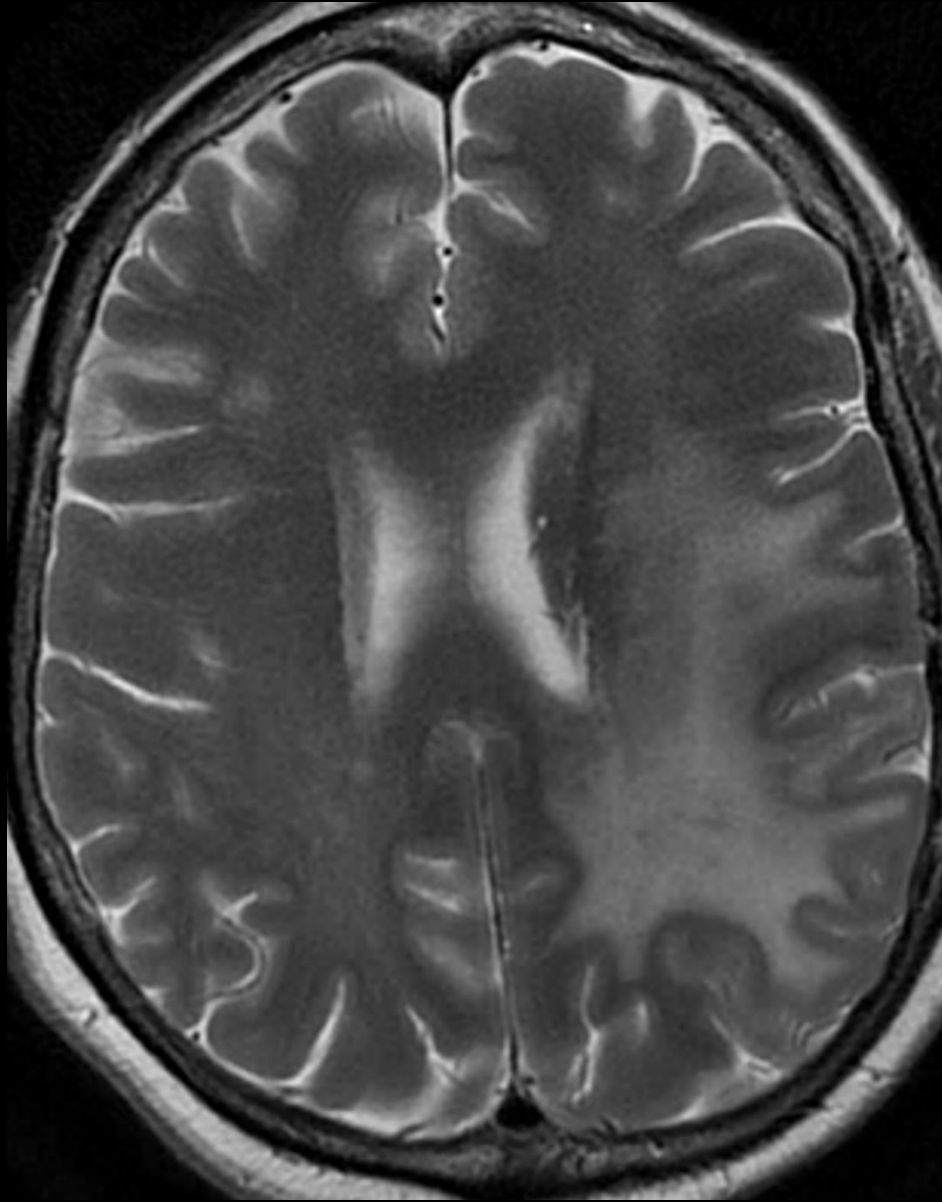
M52yr L hemiplegia ? acute episode, MRI 1

Stroke mimicks



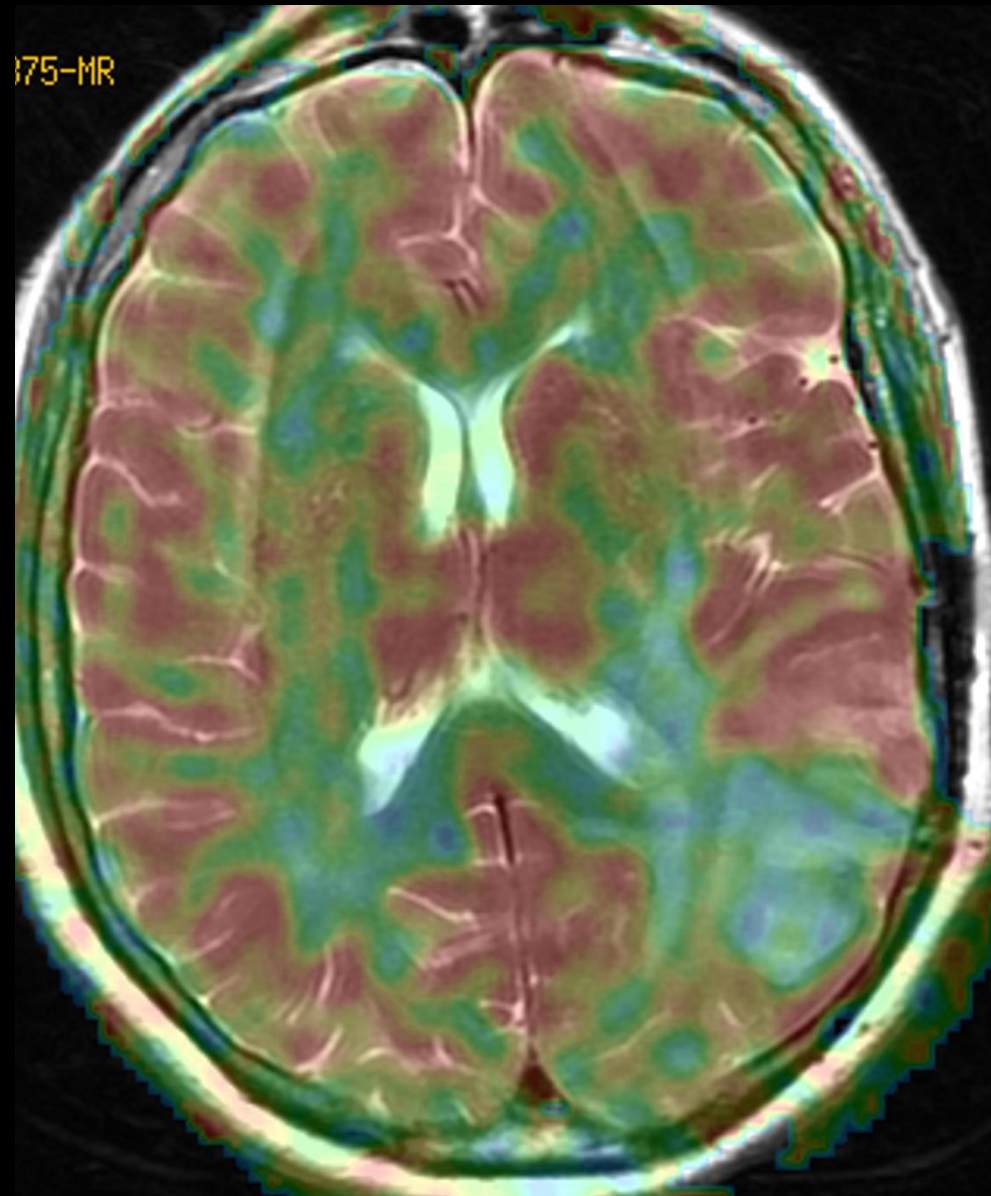
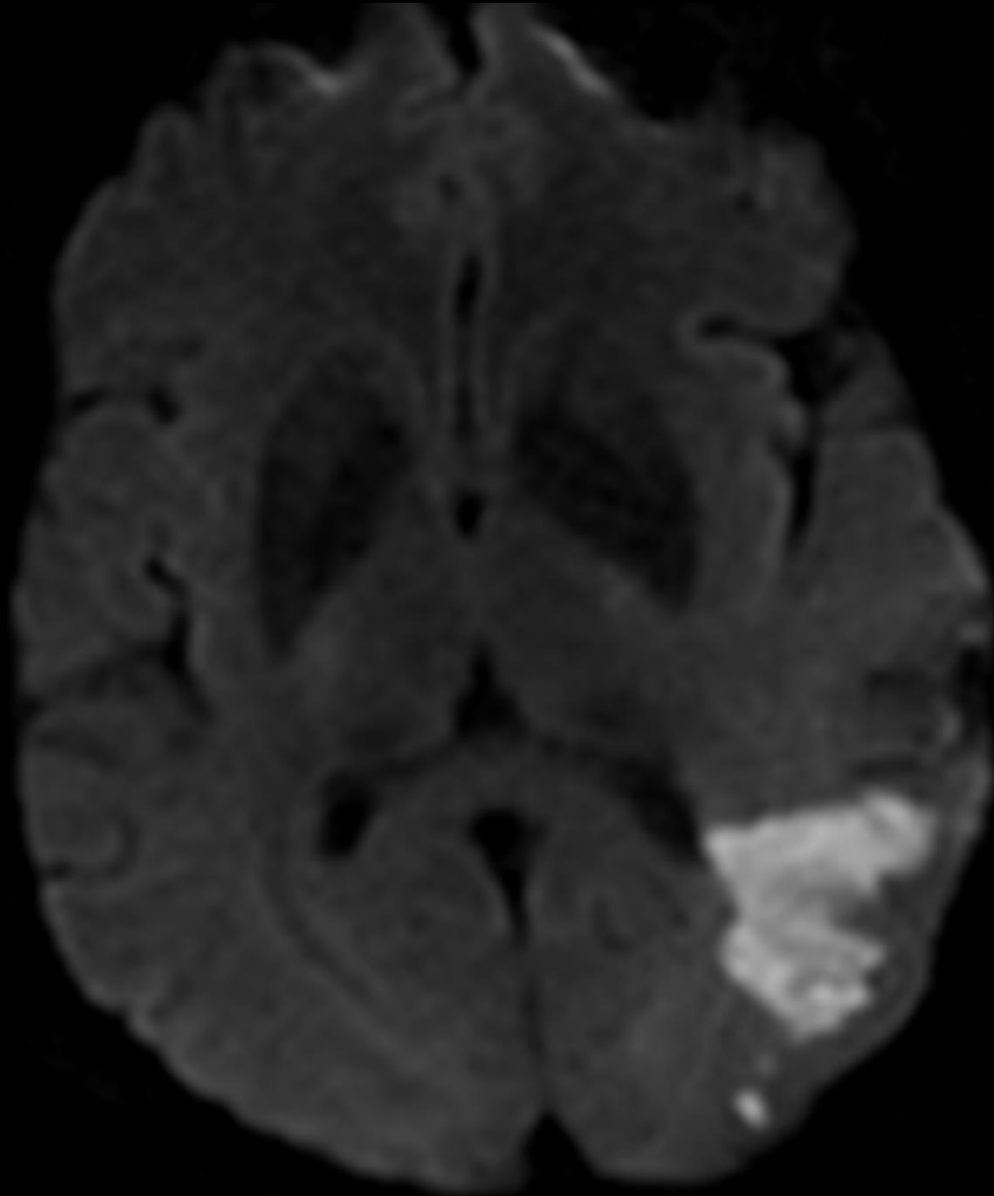
M52yr L hemiplegia ? acute episode, CT-PET chest lung Ca

Stroke mimicks



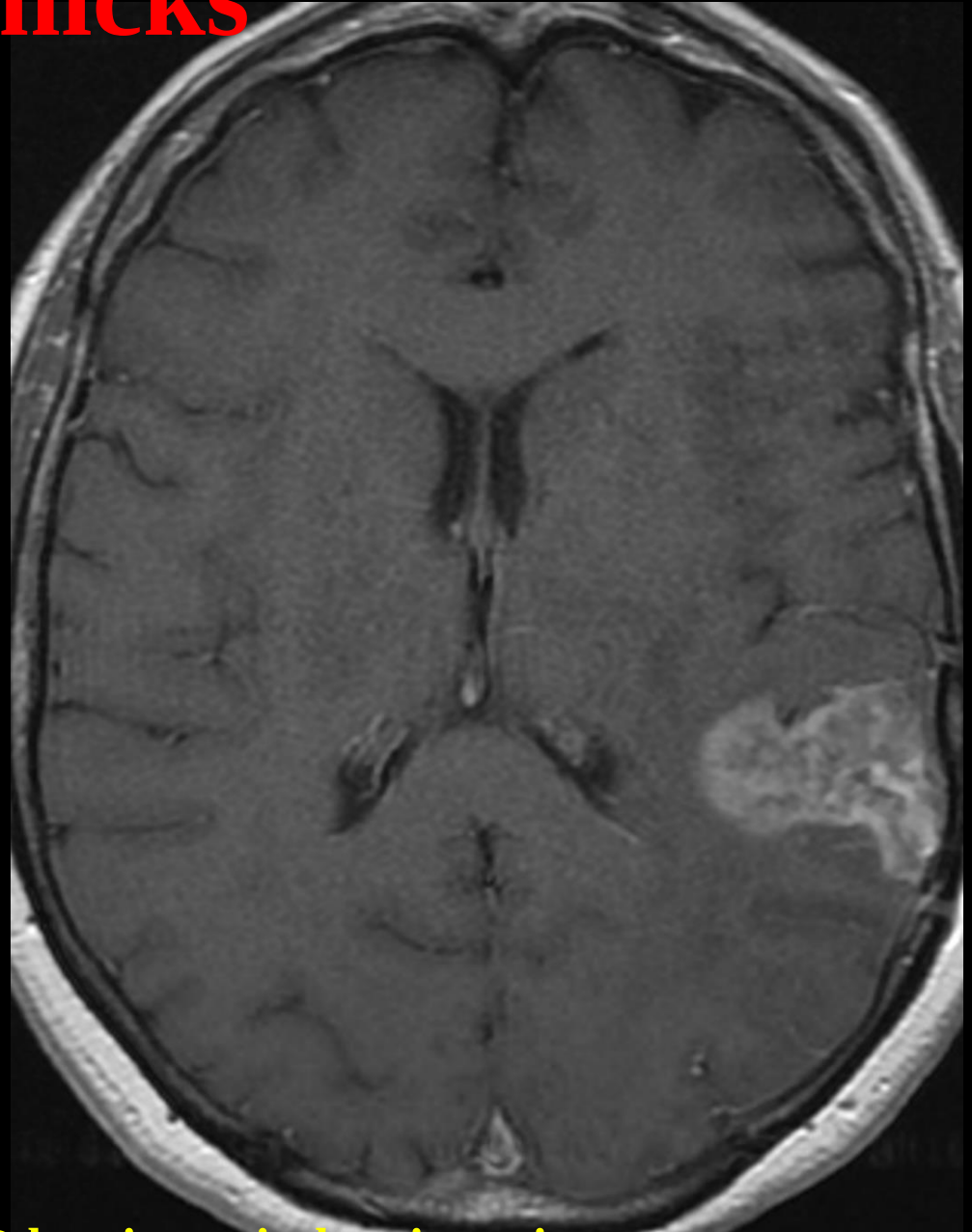
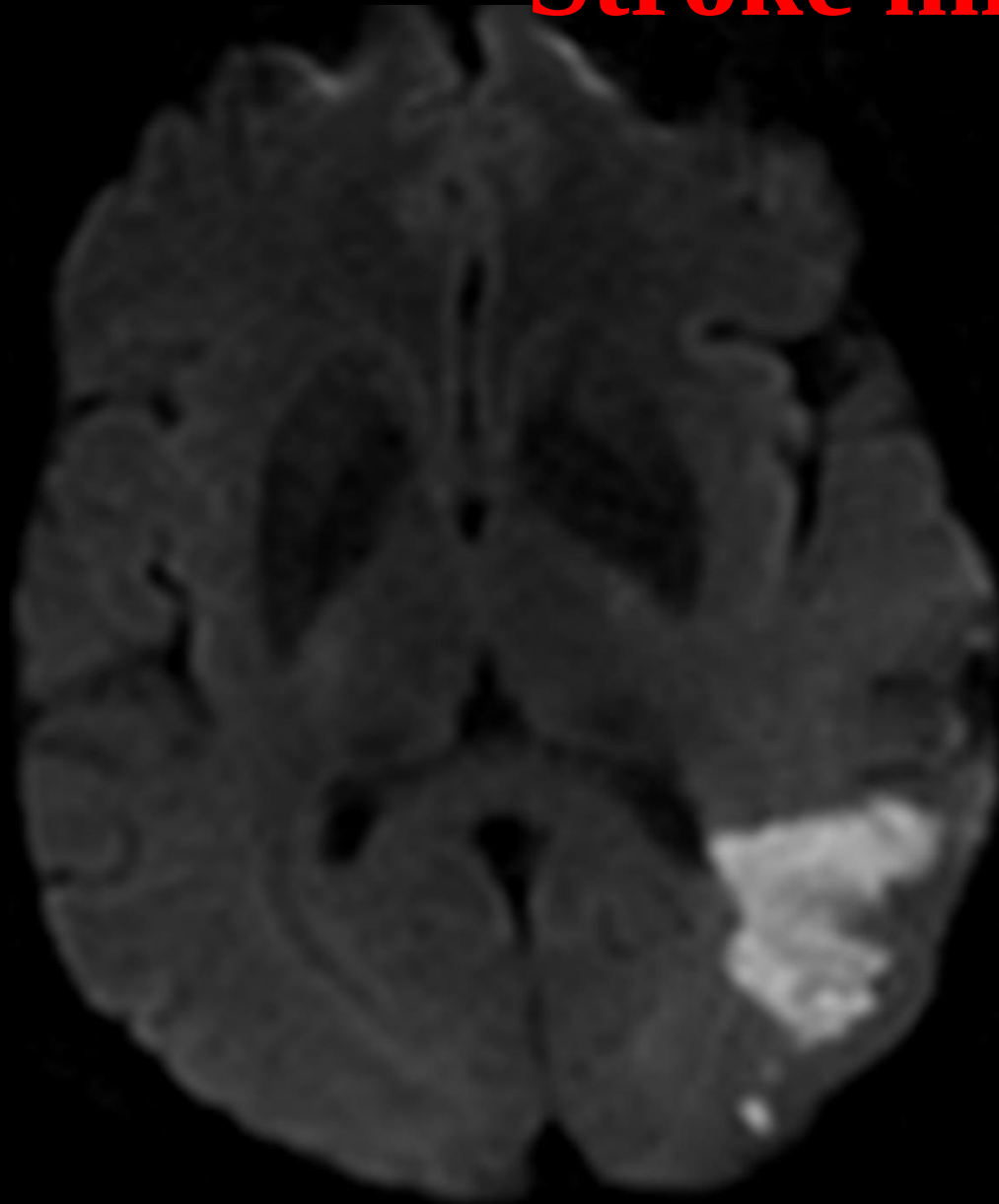
F63yr Acute onset dysphasia, R hemiparesis, hemianopia

Stroke mimicks



F63yr Acute onset dysphasia, R hemiparesis, hemianopia

Stroke mimicks



F63yr Acute onset dysphasia, R hemiparesis, hemianopia

Stroke

“Clinical stroke mimicks”

- clinical-only evaluation → “stroke mimicks” up to 20%
- clinical + imaging evaluation (NECT) → reduces to < 3%

Causes

- seizure*
- complicated migraine*
- conversion disorders*
- tumour
- demyelination - acute plaques
- infection - meningoencephalitis

Stroke

Clinical features of “Stroke mimicks”

Psychogenic	Lack of objective cranial nerve findings, neurological findings in a nonvascular distribution, inconsistent examination
Seizures	History of seizures, witnessed seizure activity, postictal period
Hypoglycemia	History of diabetes, low serum glucose, decreased level of consciousness
Migraine with aura (complicated migraine)	History of similar events, preceding aura, headache
Hypertensive encephalopathy	Headache, delirium, significant hypertension, cortical blindness, cerebral edema, seizure
Wernicke’s encephalopathy	History of alcohol abuse, ataxia, ophthalmoplegia, confusion
CNS abscess	History of drug abuse, endocarditis, medical device implant with fever
CNS tumor	Gradual progression of symptoms, other primary malignancy, seizure at onset
Drug toxicity	Lithium, phenytoin, carbamazepine

Stroke

True stroke

Stroke

Stroke:

- **Ischemic Stroke (ASCO phenotypic system)**
 - **A**therosclerotic thromboembolic infarcts (40-45% all strokes)
commonest, atherosclerotic plaque, carotid bifurcation > siphon
thromboemboli to large arteries esp MCA
 - **S**mall-vessel occlusion (lacunar) (15-30% all strokes)
penetrating vessels, subcortical <15mm, thromboembolic, atherosclerotic
 - **C**ardioembolism (15-25% all strokes)
IHD-MI, valvular disease, arrhythmia, AF
 - **O**ther - indeterminant
- **Hemorrhagic Stroke**

Reference: “ASCO phenotypic system”

Stroke

Ischemic Stroke

TOAST Classification

- Large-artery atherosclerosis - thromboembolic
- Cardioembolism
- Small-vessel occlusion (lacune)
- Stroke - indeterminate aetiology
 - a. ≥ 2 causes identified
 - b. negative evaluation – no cause identified
 - c. incomplete evaluation

Reference: “Trial of Org 10172 in Acute Stroke Treatment (TOAST)”

Stroke

TOAST Classification Ischemic Strokes					
Features		Large artery atherosclerosis	Cardioembolism	Lacunar infarct	Other
Clinical					
	cortical,cerebellar syn.	+	+	-	+/-
	lacunar syn.	-	-	+	+/-
Imaging					
	corticocerebellar, brainstem, subcortical infarct >15mm	+	+	-	+/-
	subcortical or brainstem infarct <15mm	-	-	+/-	+/-
Other		ICA stenosis	cardiac source/PEO	-	other

Stroke

Ischemic Stroke:

Imaging Infarct Aging

- “Hyperacute infarct” < 12hrs = “acute stroke thrombolysis group”
- “Acute infarct” > 12hrs - 7days
- “Subacute infarct” 7 - 30 days
- “Chronic infarct” > 30 days

Stroke

Imaging Goals in Clinical Acute Stroke:

- **Exclude stroke mimicks (3-20%)**

imaging unable to exclude seizure/conversion disorders

- **Exclude acute hemorrhagic lesions**

absolute contraindication to acute thrombolysis → SDH, SAH, ICH, IVH

- **Confirm clinical acute ischaemic stroke**

CT >> MRI acute infarct signs

significant CT “normal imaging” rate < 4.5hrs

- **Characterisation acute ischaemic stroke penumbra/core**

determine potential thrombolysis treatment target → penumbra zone

penumbra = ischemic but viable “at risk” tissue

- **Cardiovascular imaging**

cardiovascular assessment for stroke causation

Stroke

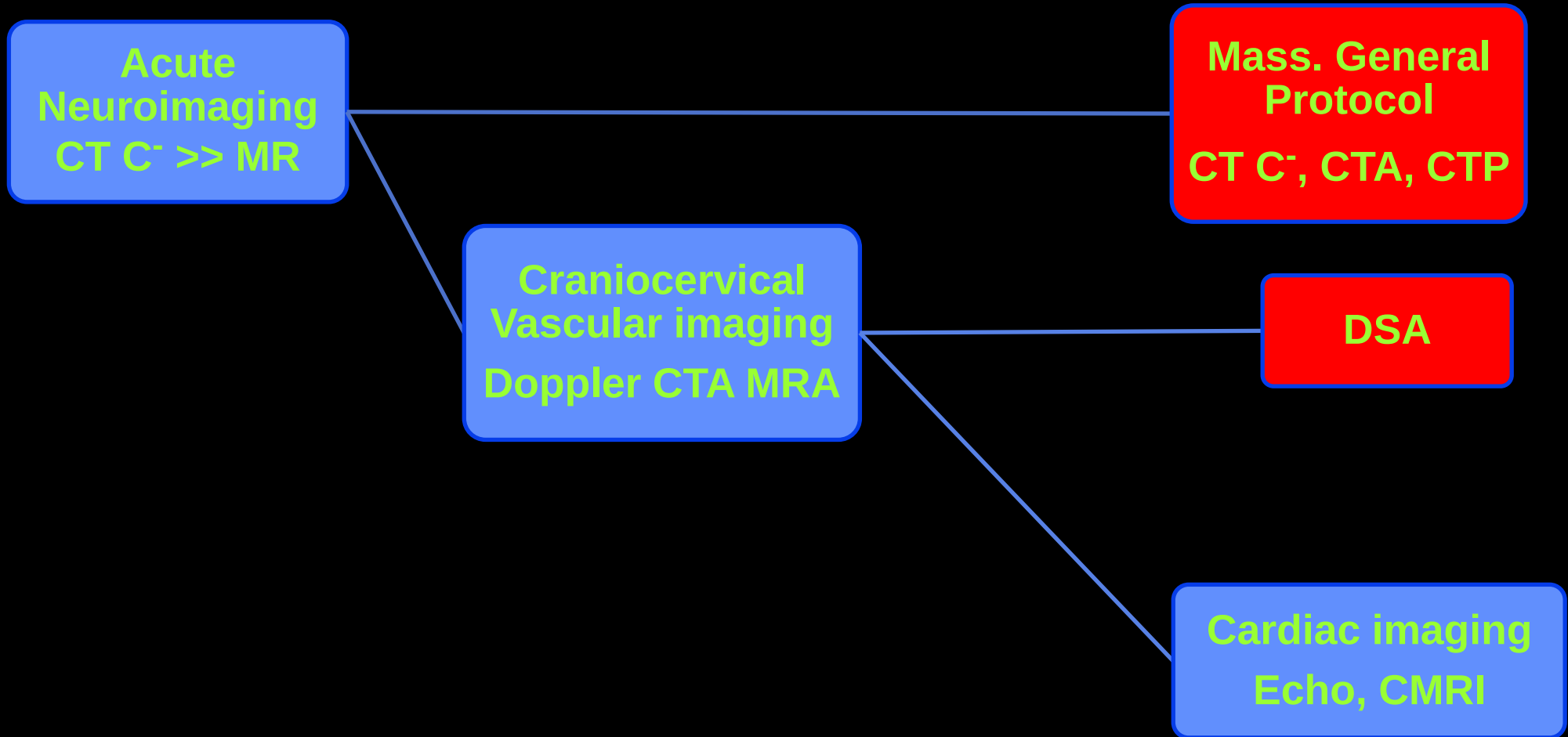
Imaging Goals Acute Stroke:

x 4 “P’s”

- “P” – **parenchyma**
confirm acute ischemic stroke, exclude mimics/hemorrhage
- “P” – **perfusion**
CT perfusion, $MTT \uparrow \times CBF \downarrow = CBV$ classification
CBV compensated, oligaemic
CBV ischemic penumbra, infarct core
- “P” – **penumbra**
determine potential Rx target = ischaemic but viable tissue
- “P” – **pipes**
assess craniocervical vessels and intracardiac structures

Stroke

Acute Stroke Imaging



Stroke

Strategy:

- **Neuroimaging**

- CT +/- CT perfusion

- MR +/- MR perfusion (Gadolinium DSC or ASL)

- **Neurovascular Imaging**

- Intracranial – CTA or MRA +/- DSA

- Extracranial – Doppler US, CTA or MRA +/- DSA

- **Cardiac Imaging**

- Echocardiography – TTE or TOE

- Cardiac MRI

- **Medical Workup**

- Blood screen, Coagulation screen, ECG, Telemetry-Holter

Stroke

Haemorrhagic stroke

Stroke

Hemorrhagic Stroke, ICH:

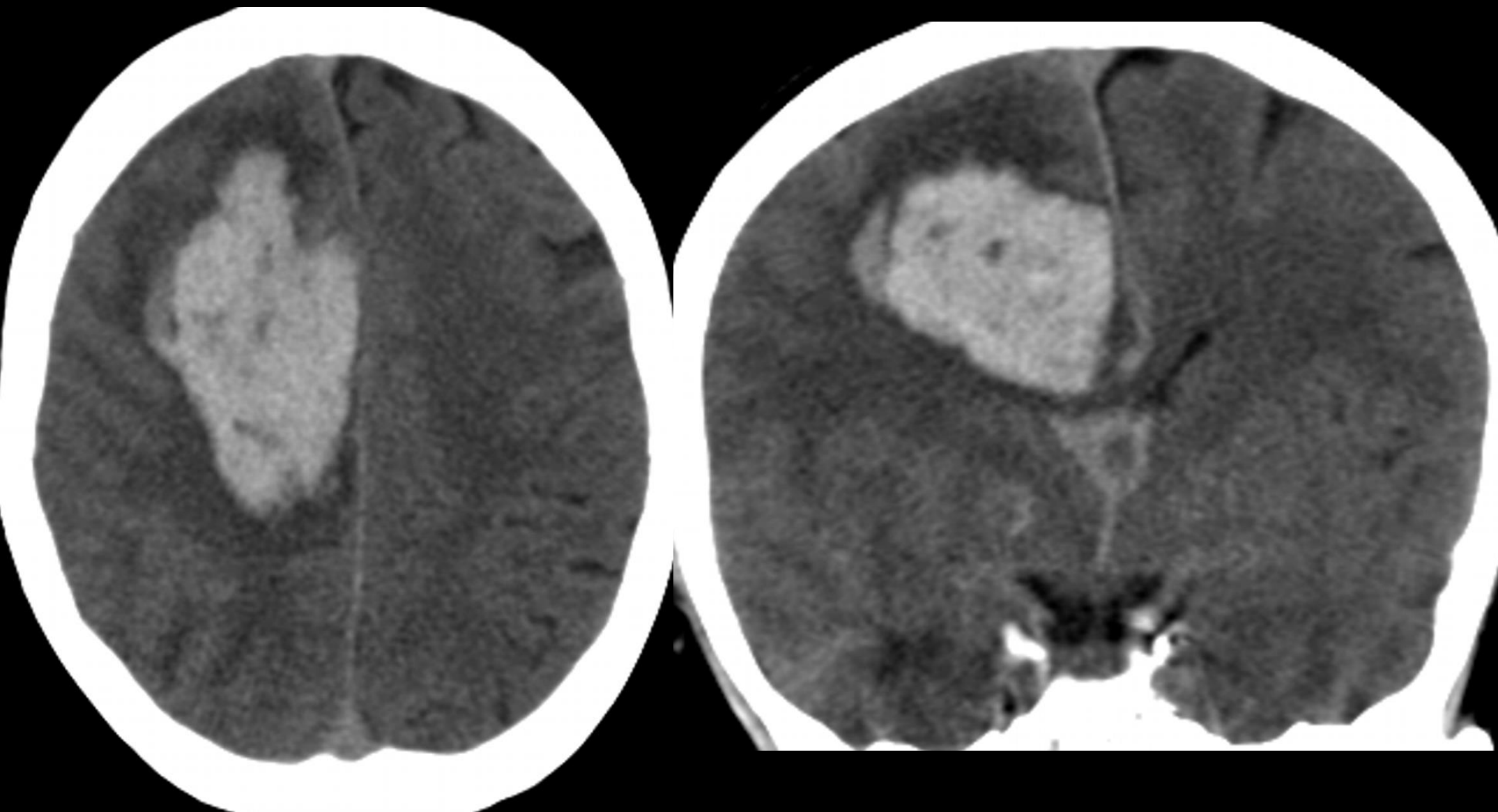
- Traumatic
- Hypertensive
 - Arteriosclerotic – Primary ICH
- Infarction
 - Arterial ischemic infarct (hemorrhagic transformation)
 - Venous infarction (DVST hemorrhage)
- Angiopathy
 - CAA – Primary ICH
- Aneurysm
 - Berry aneurysm (saccular, congenital)
 - Fusiform aneurysm (mycotic, post traumatic, dissection, atheroma)
- Vascular malformations
 - AVM pial or dural type (DAVF)
 - cavernous hemangioma (cavernoma)
 - venous angioma

Stroke Imaging

Intracranial hemorrhage (ICH)

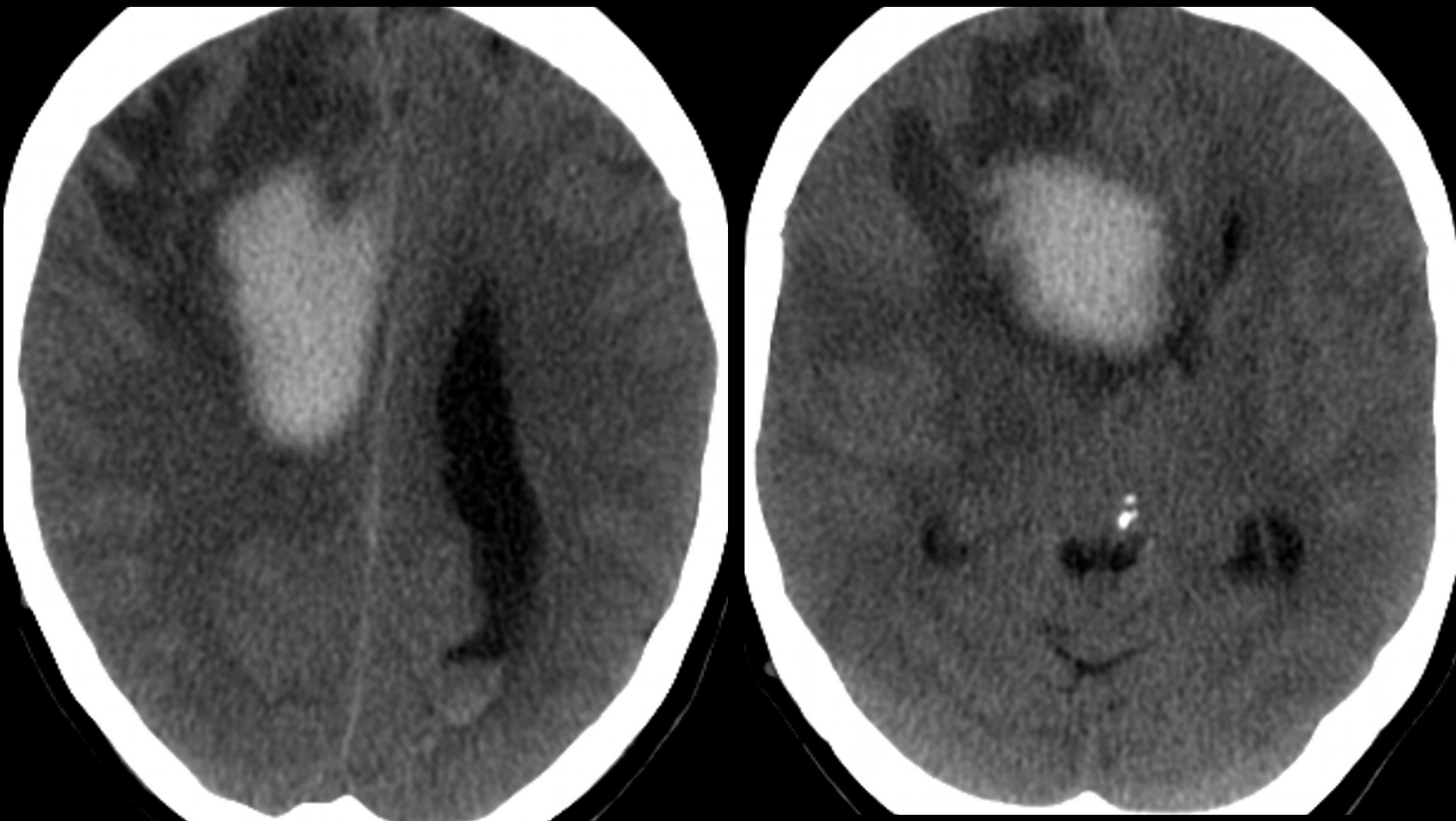
- hypertensive (primary ICH)
- cerebral amyloid/congophilic angiopathy (CAA)
- aneurysmal SAH
- “moya moya” vasculopathy

Stroke



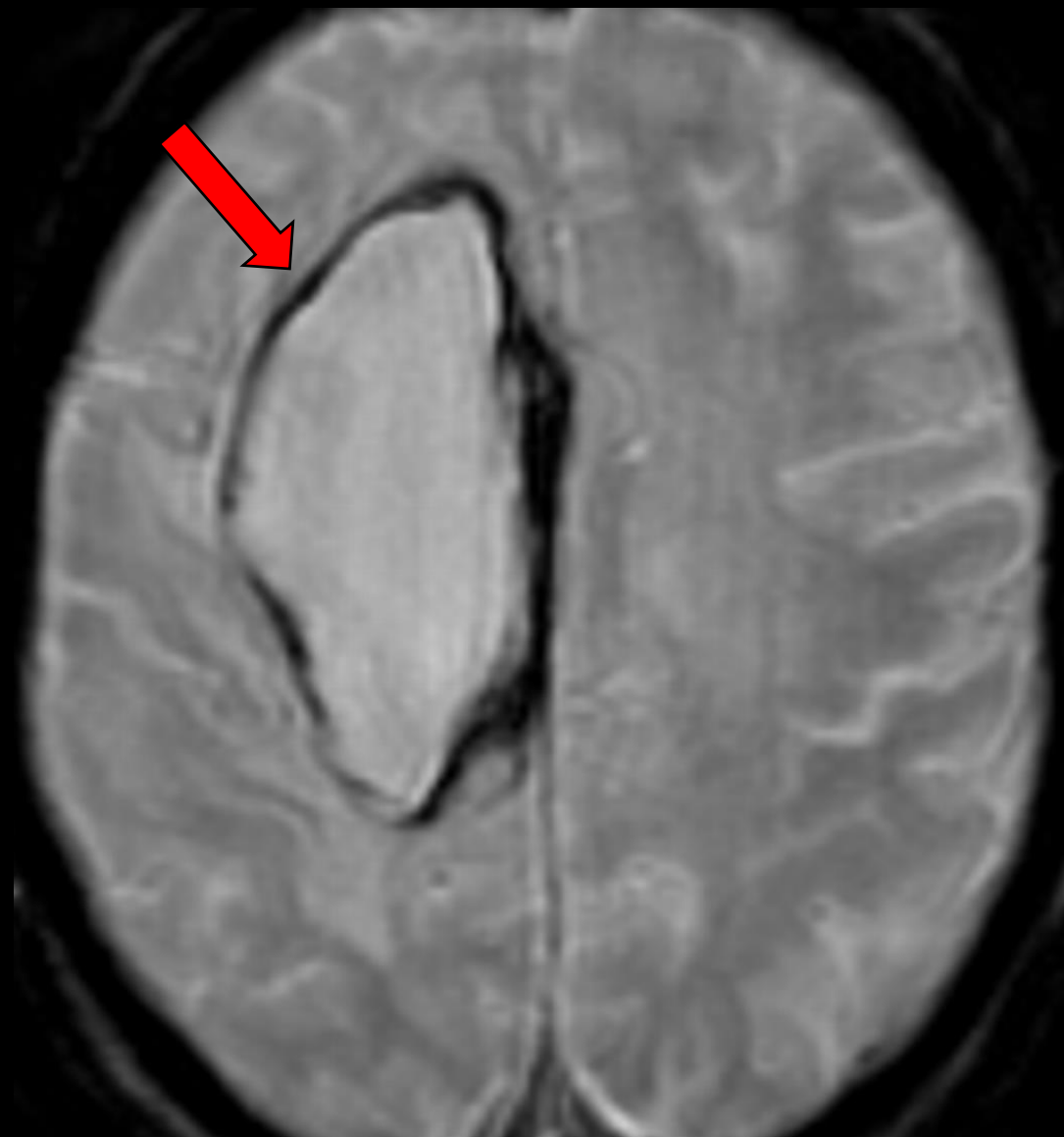
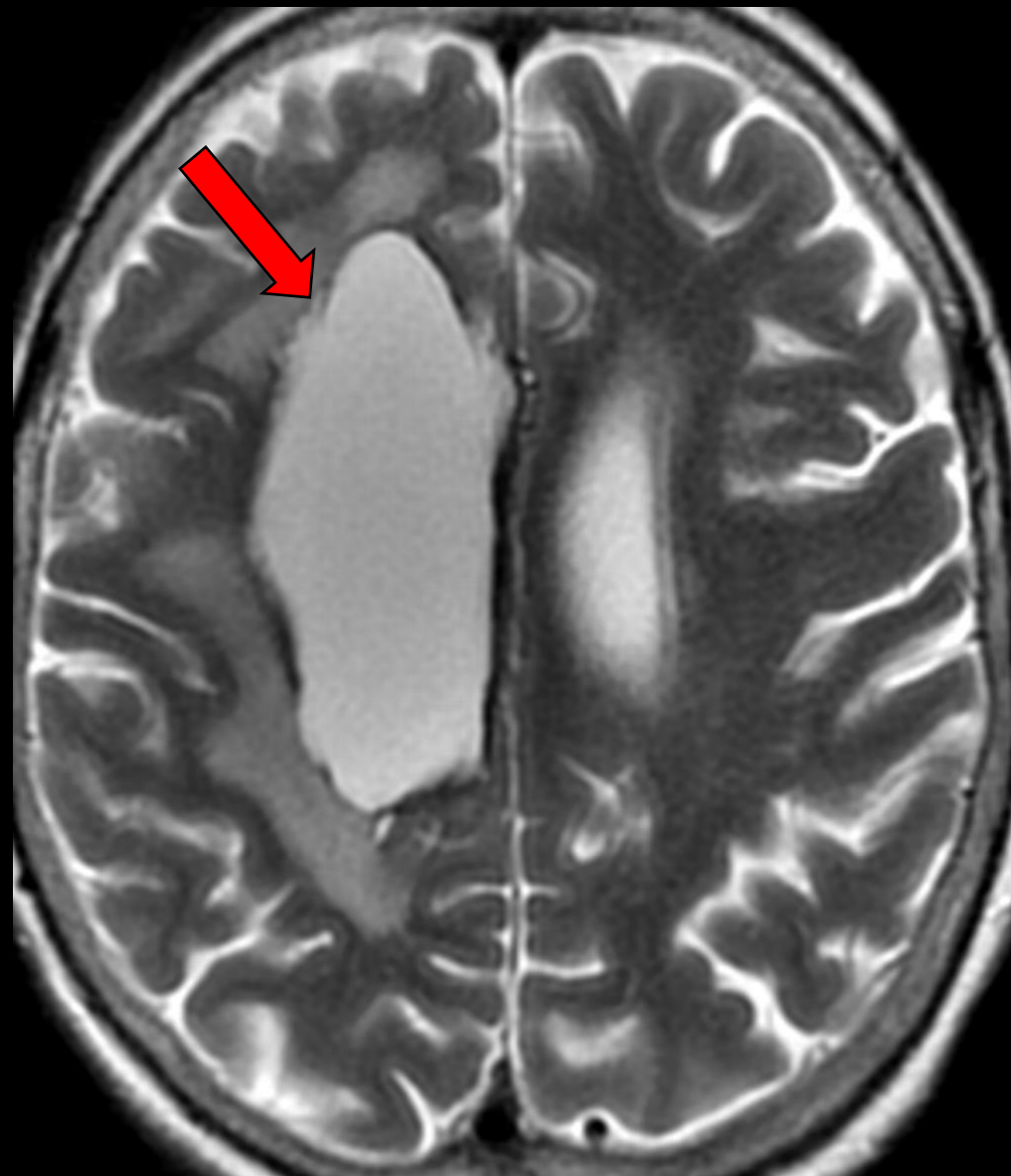
F63yr Acute right hemispheric stroke syndrome - CT 3 hours

Stroke



F63yr Lobar hemispheric subacute ICH CT 10days

Stroke



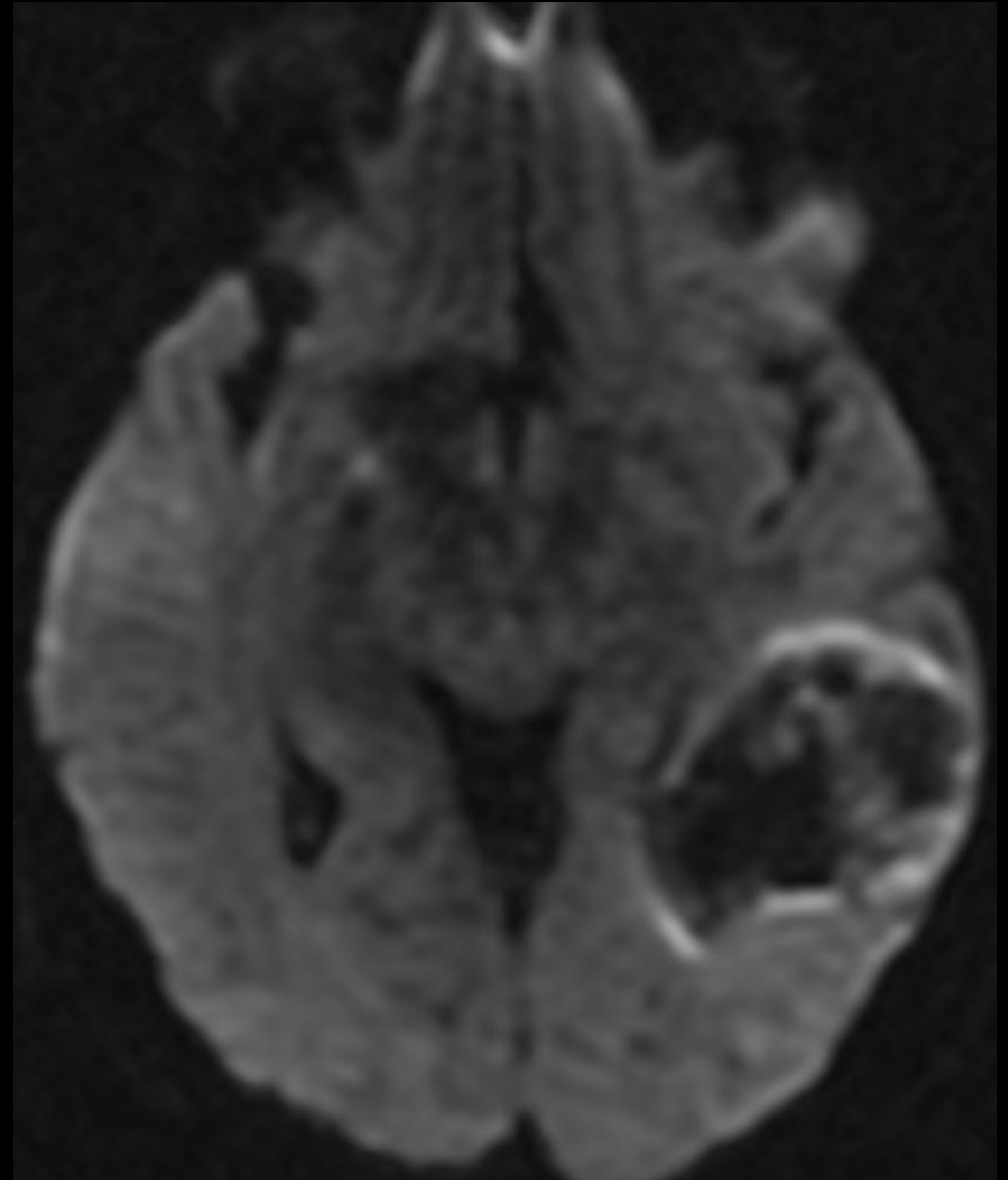
F63yr Lobar hemispheric chronic ICH MRI 1year

Stroke



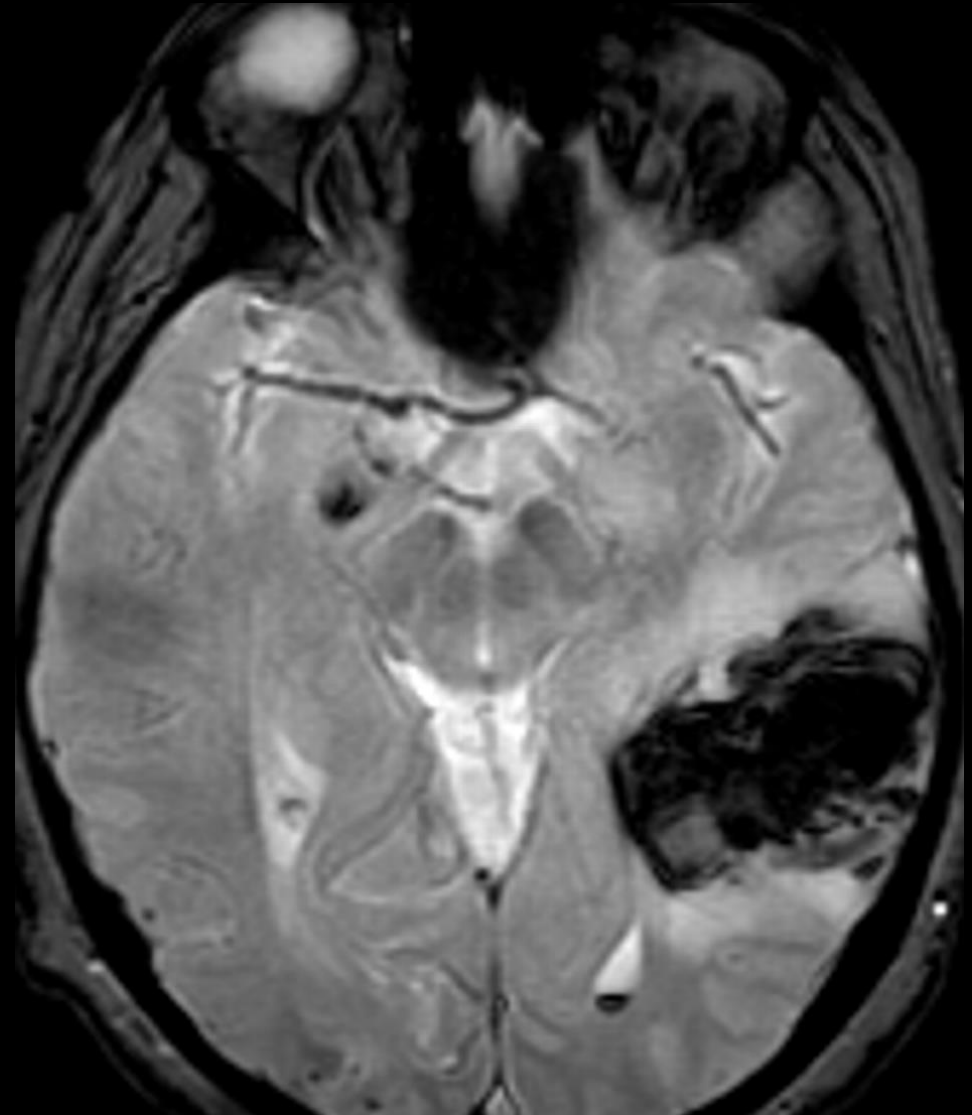
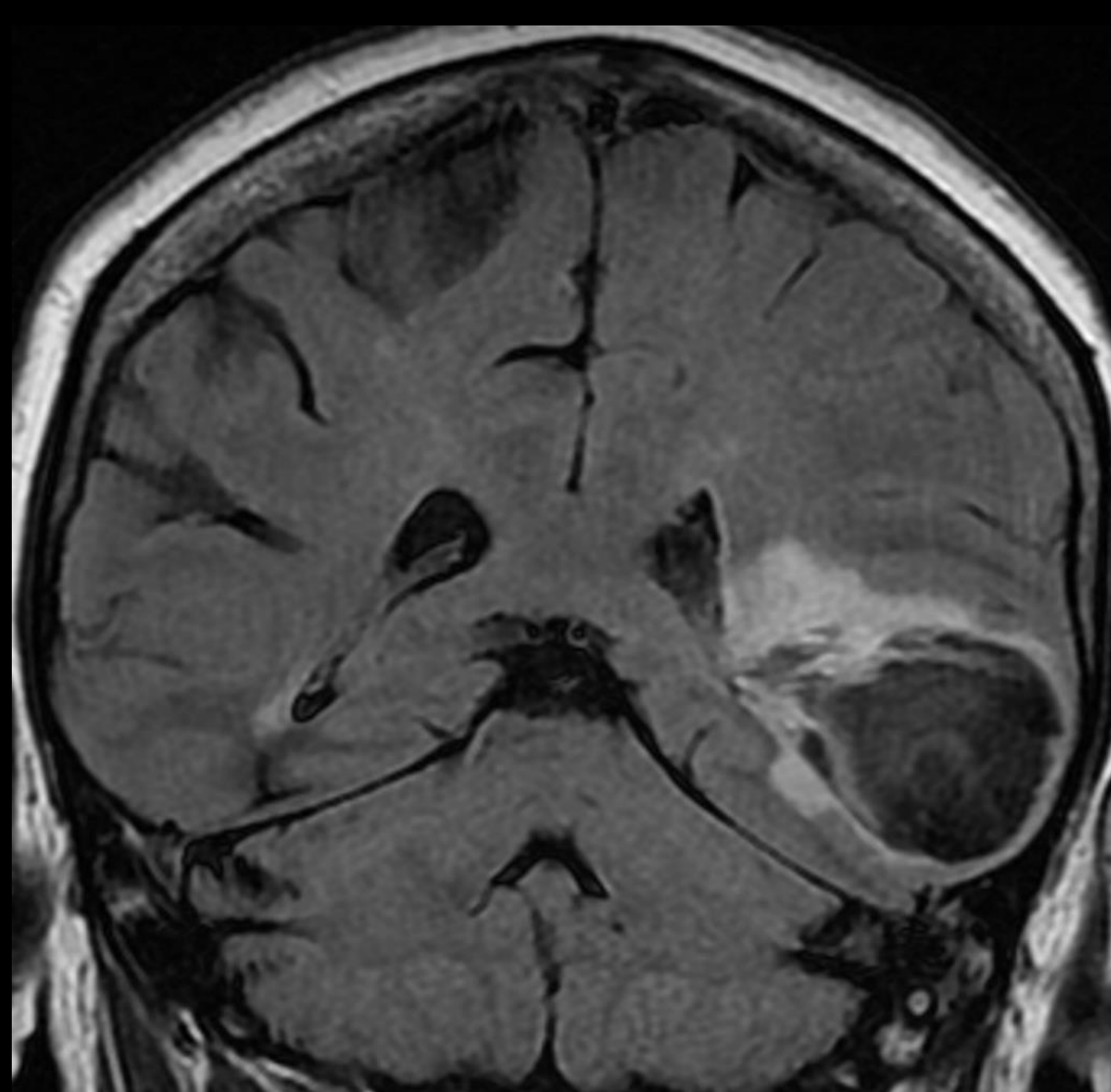
F65yr Acute L hemispheric stroke syndrome

Stroke



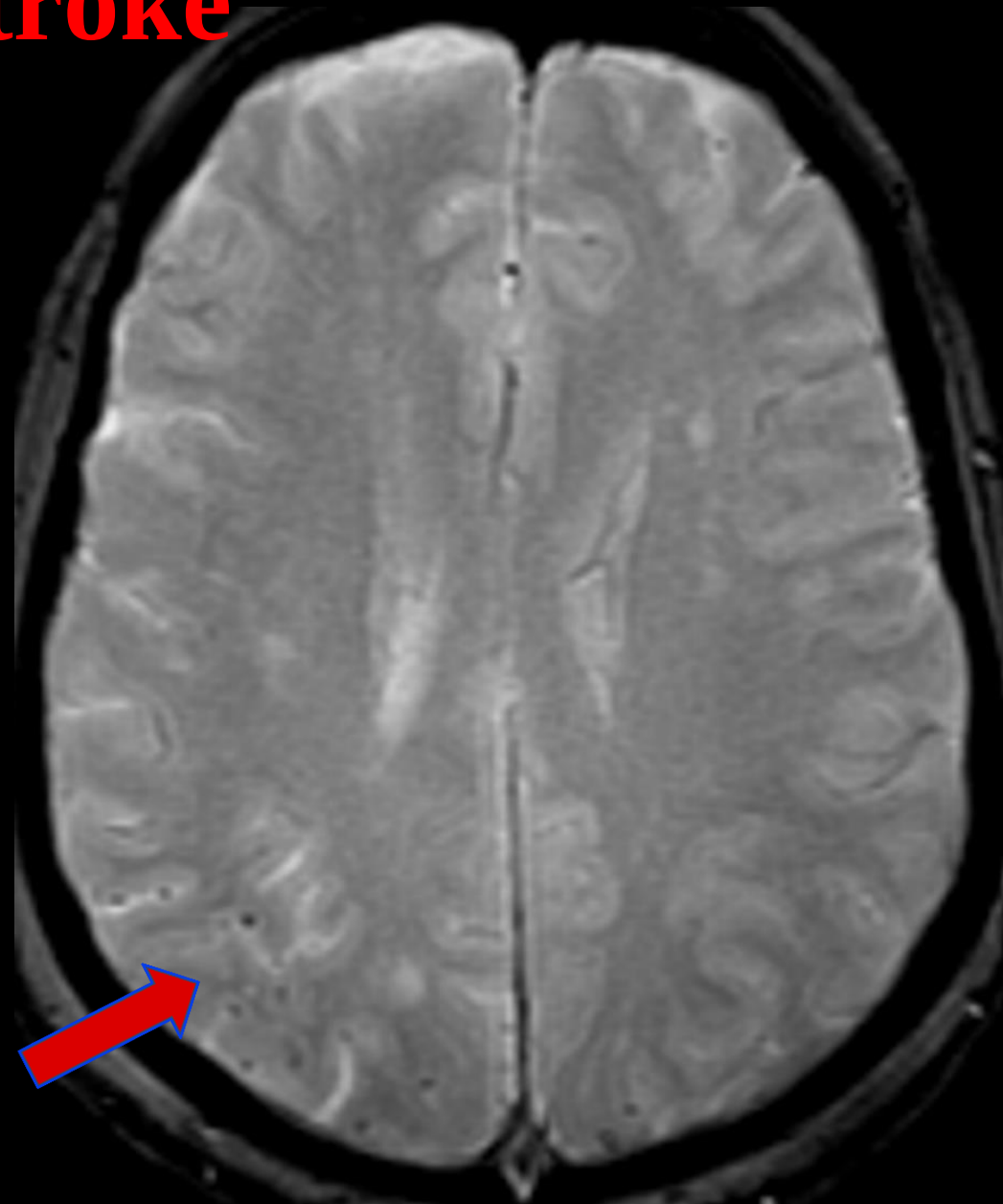
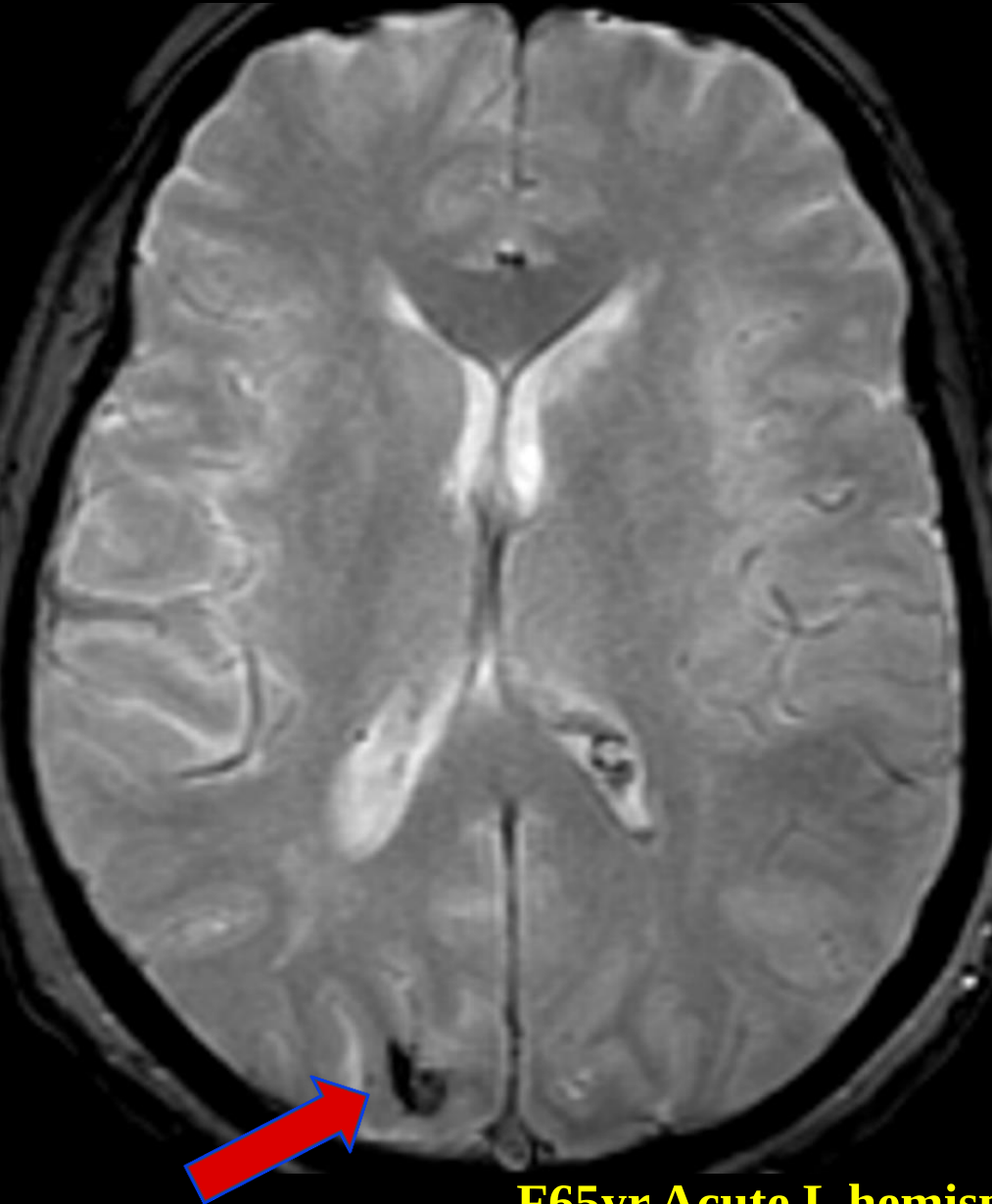
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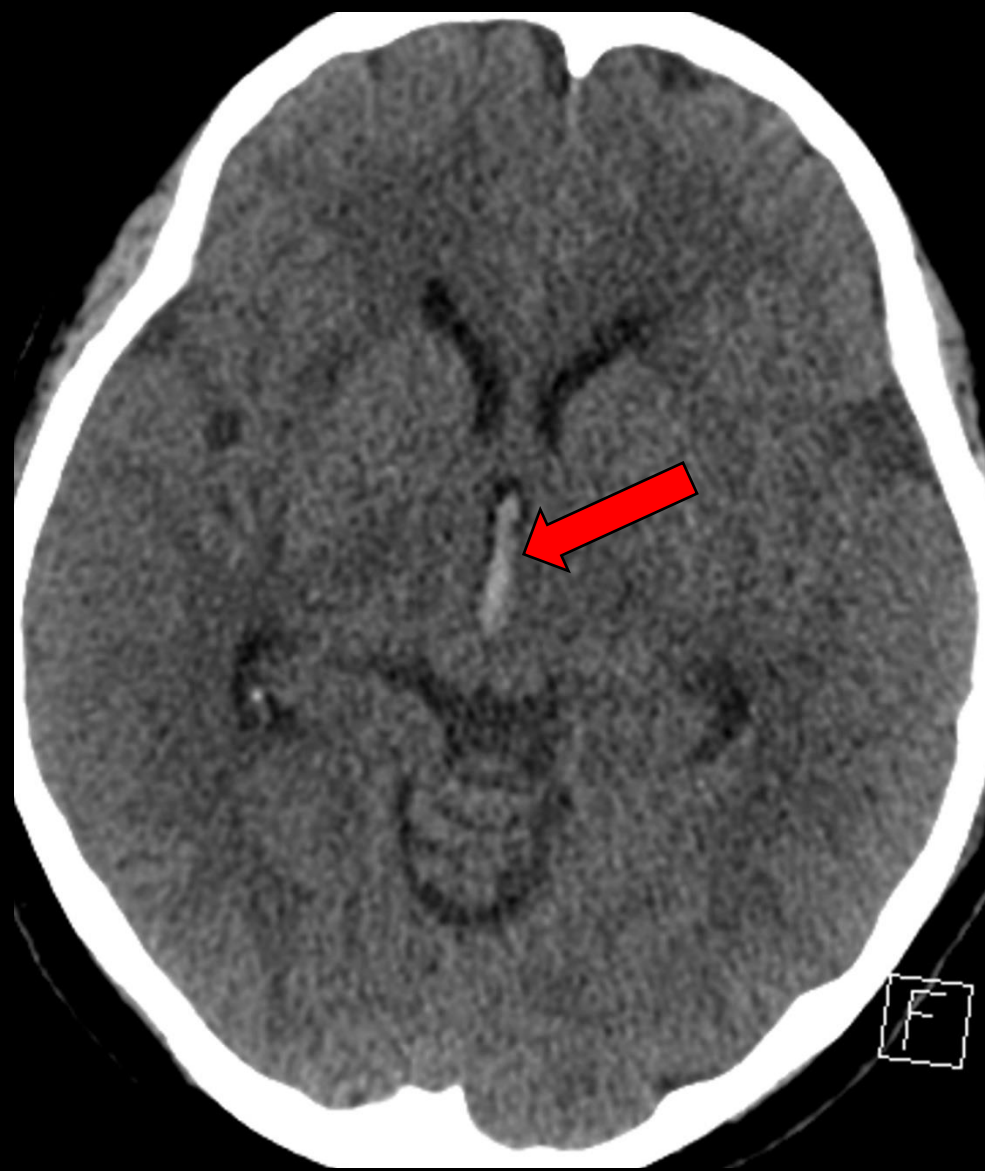
F65yr Acute L hemispheric stroke syndrome

Stroke



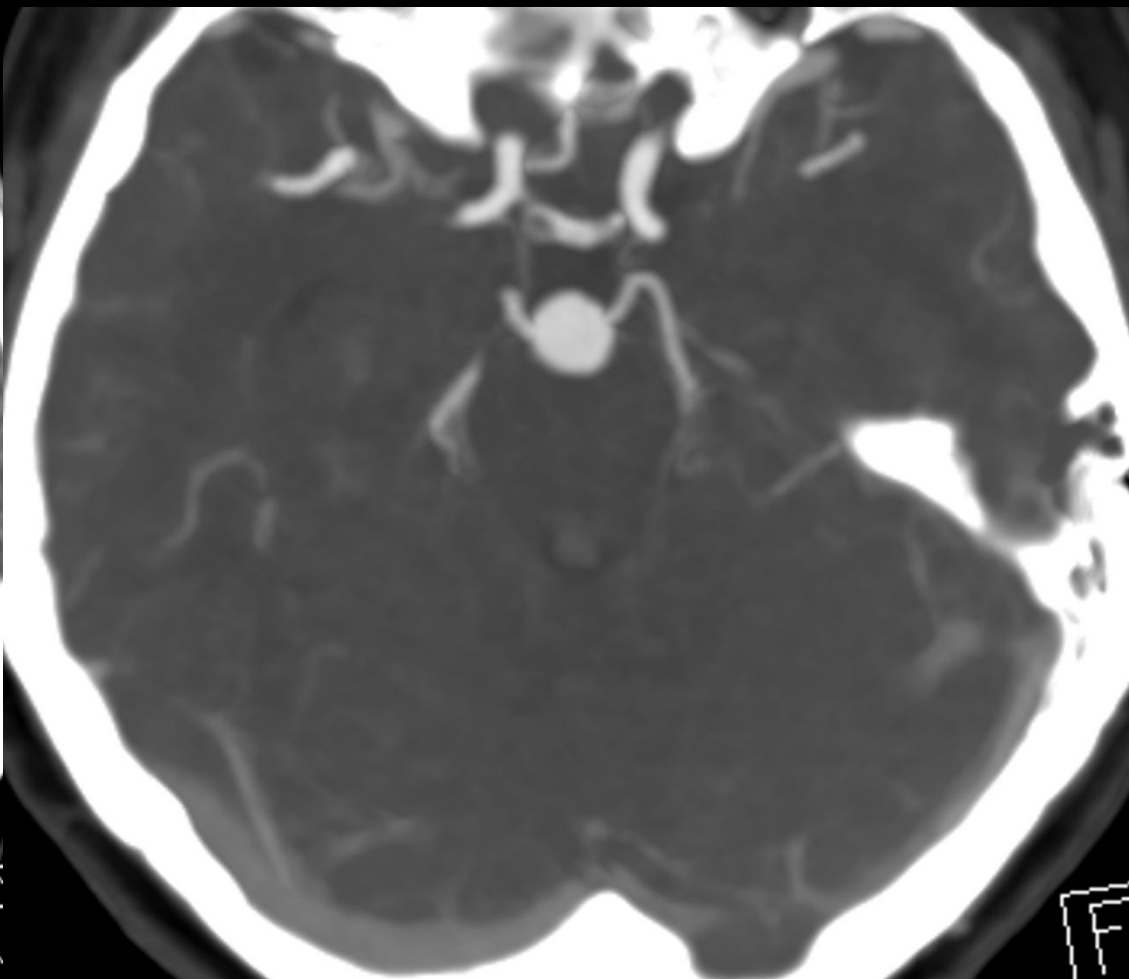
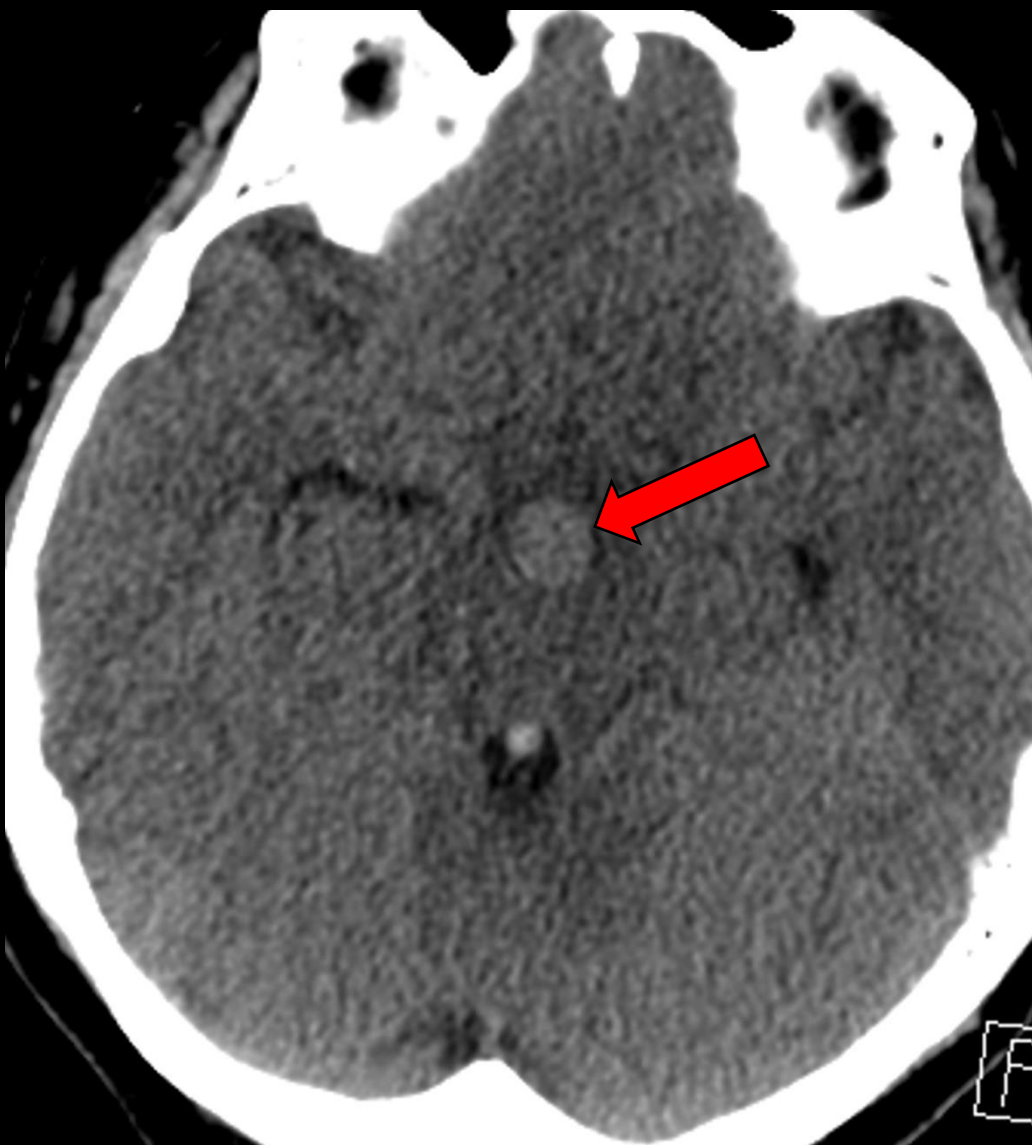
F65yr Acute L hemispheric stroke syndrome

Stroke



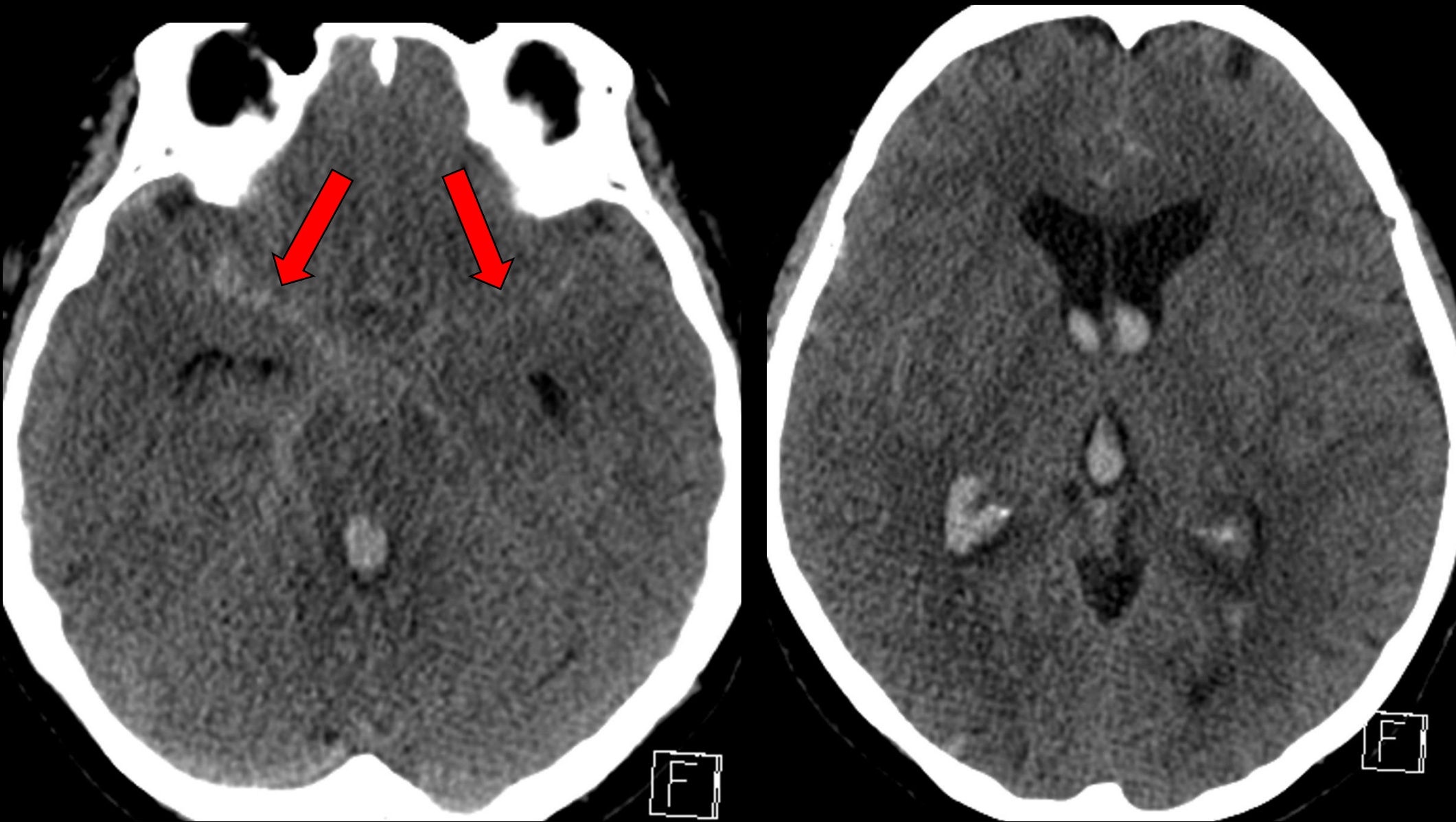
F61yr sudden onset headache, confusion, visual Δ

Stroke



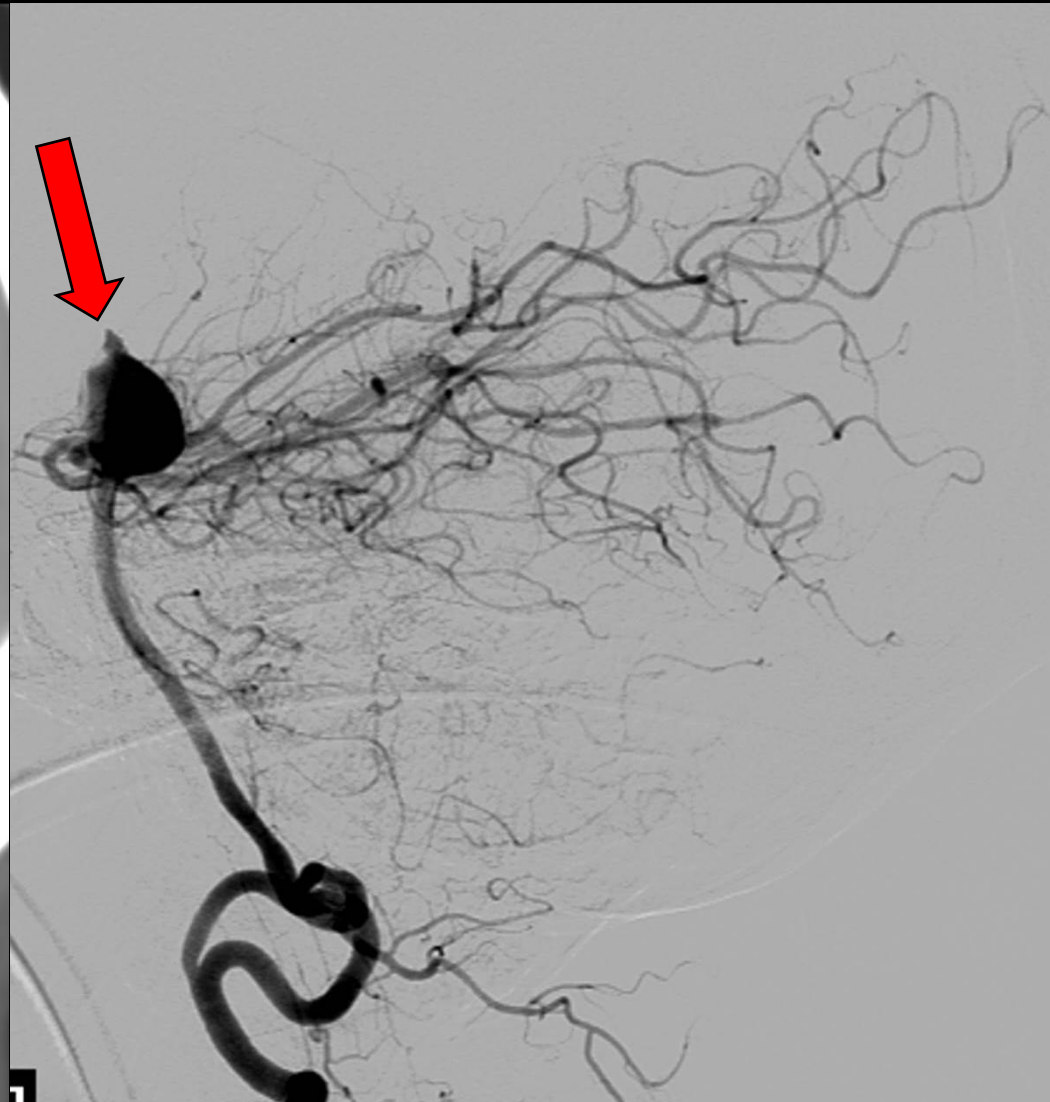
F61yr sudden onset headache, confusion, visual Δ

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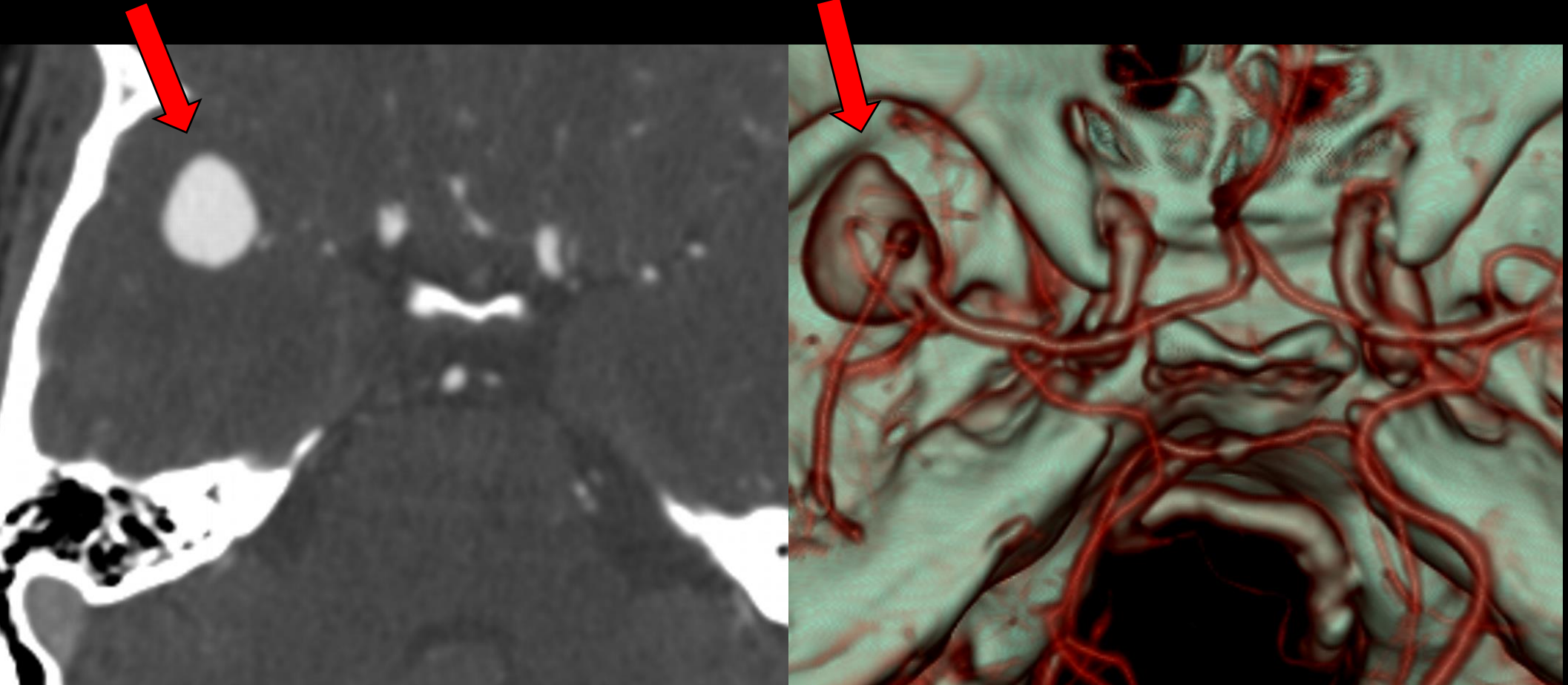
F61yr day 4 post acute SAH deterioration – CT rebleed Δ

Stroke



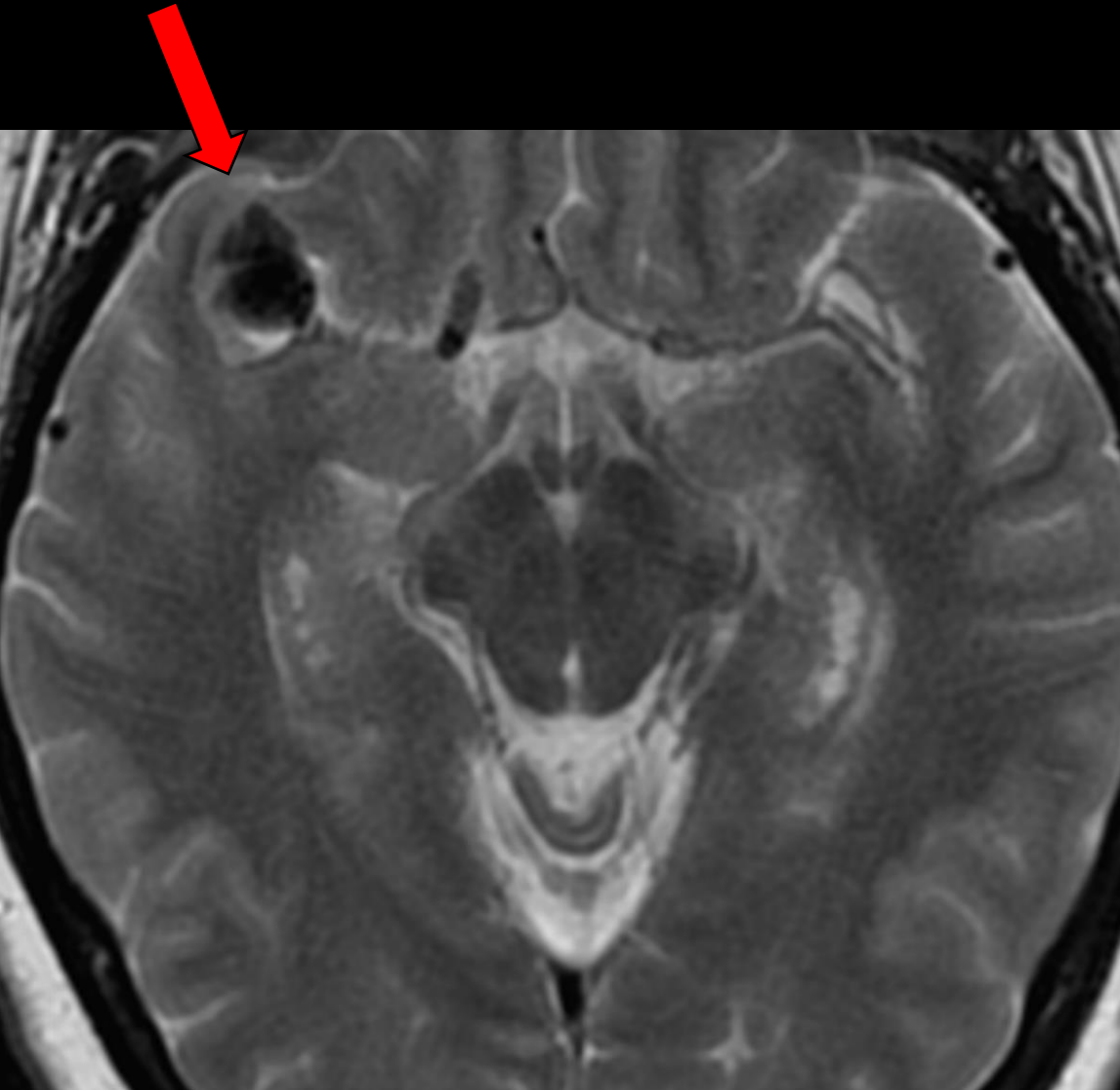
F61yr CTA/DSA basilar tip aneurysm – favorable for endovascular coiling

Stroke



F51yr recurrent headache without neurologic deficit

Stroke



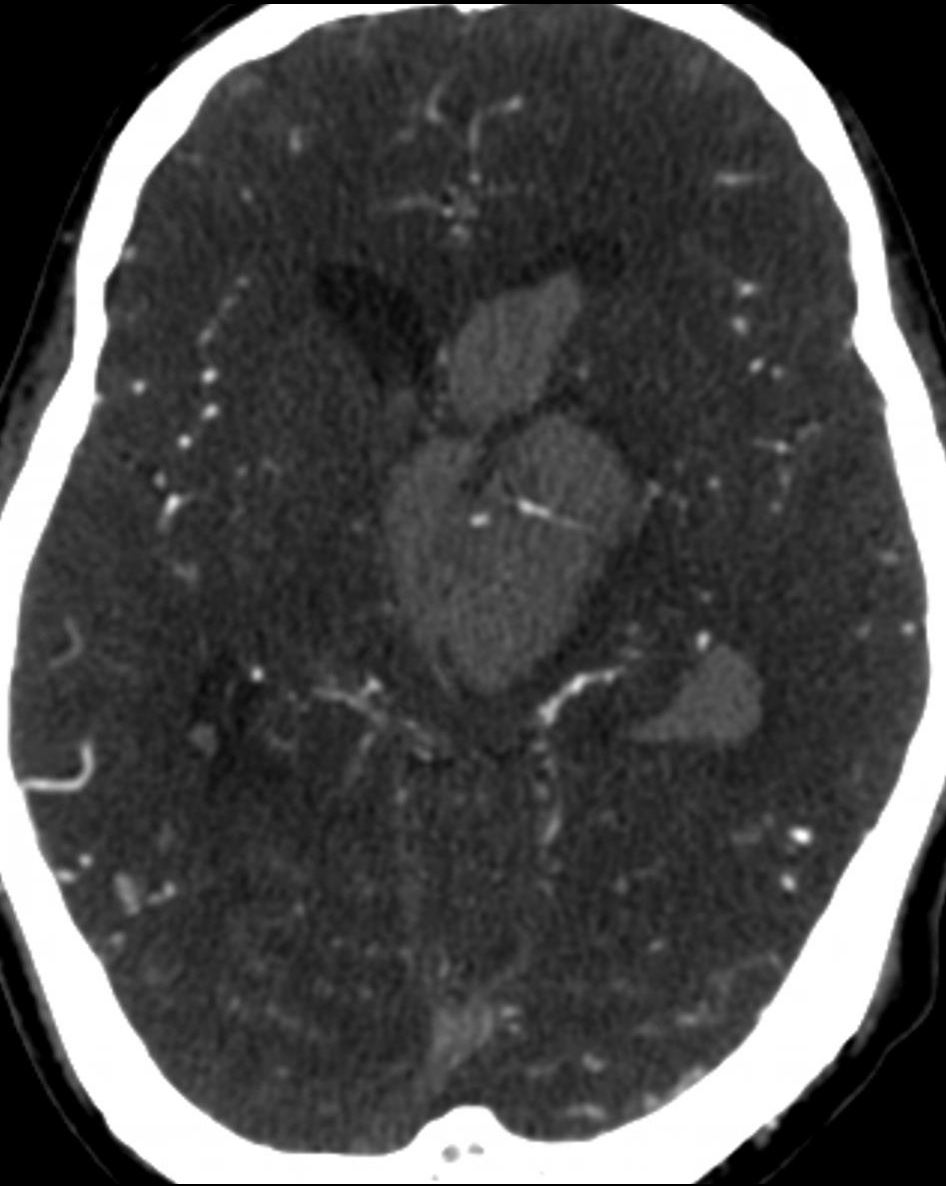
F51yr recurrent headache without neurologic deficit

Stroke



M42yr collapse GCS 6, dilated non-responsive pupils

Stroke



M42yr collapse GCS 6, dilated non-responsive pupils

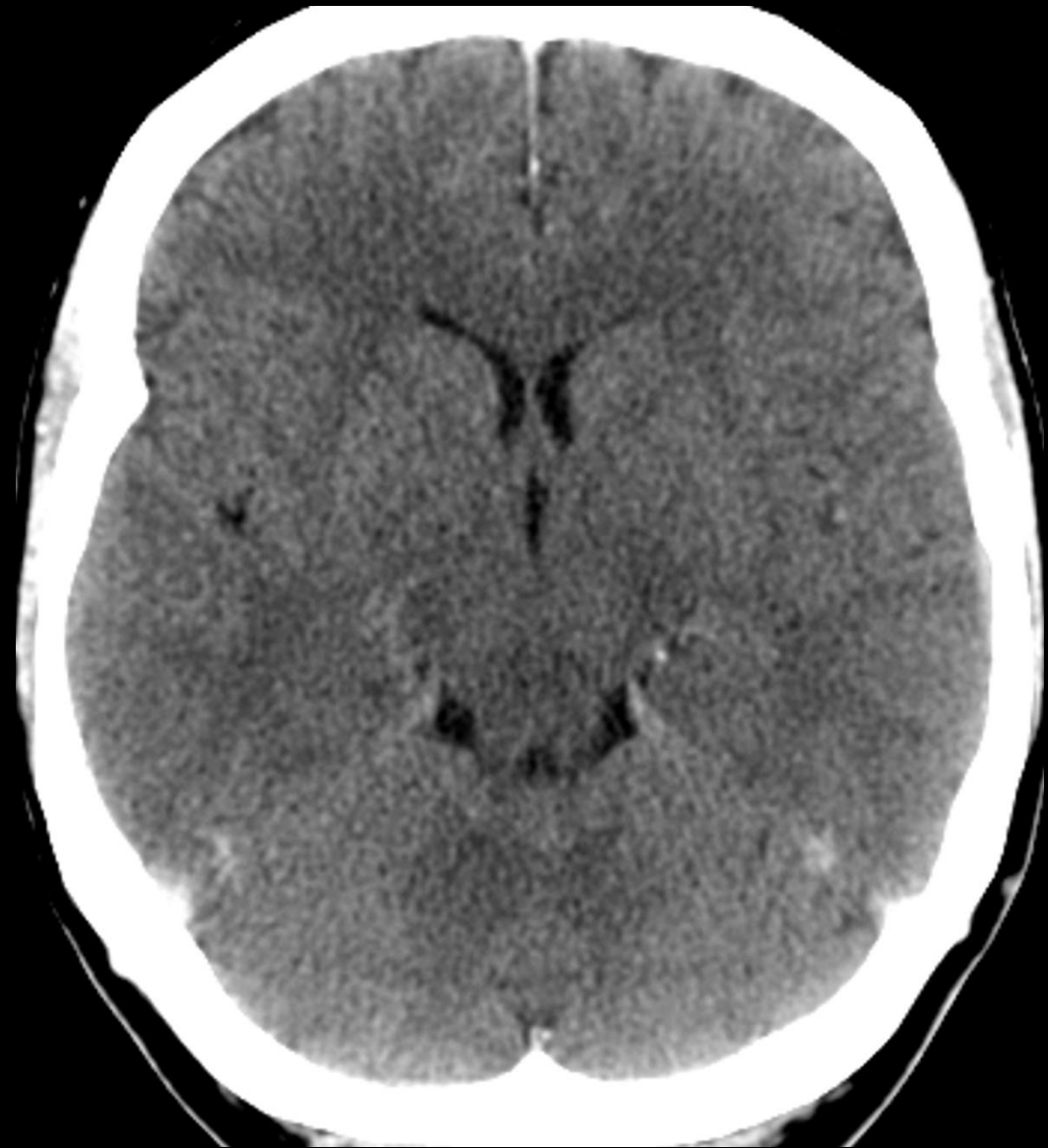
Stroke

Acute Ischemic Stroke

Stroke Imaging

Large Artery Thromboembolic Infarction

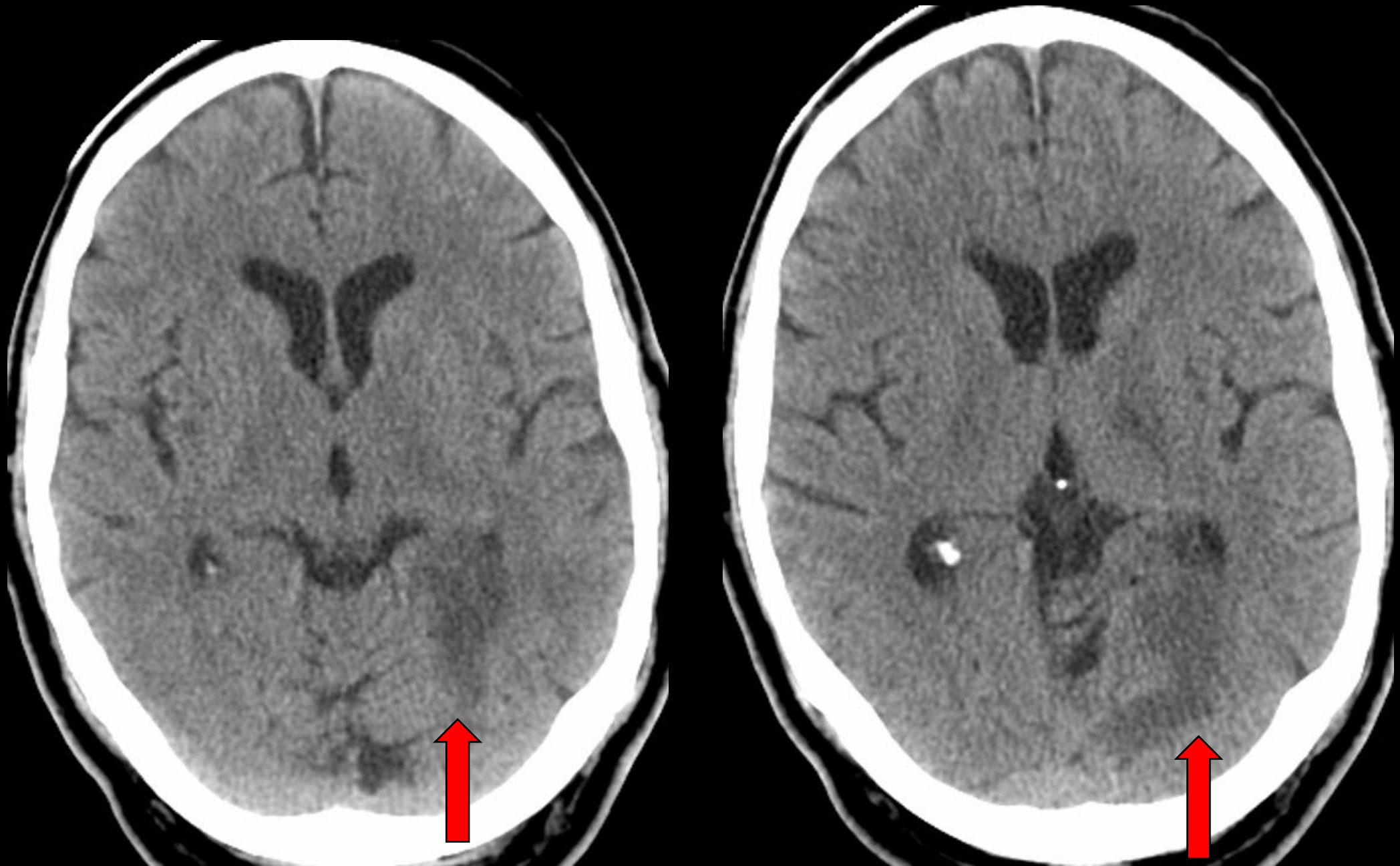
Stroke



Stroke



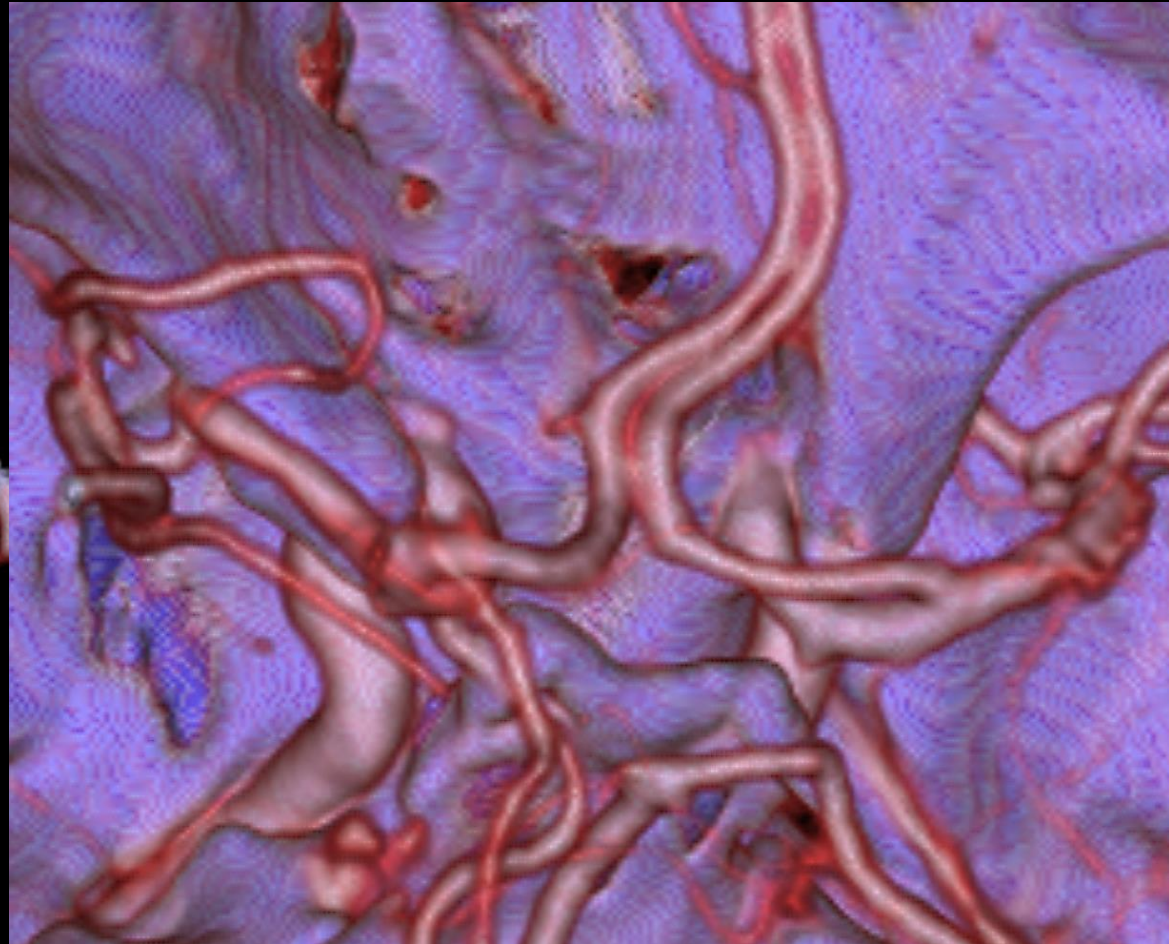
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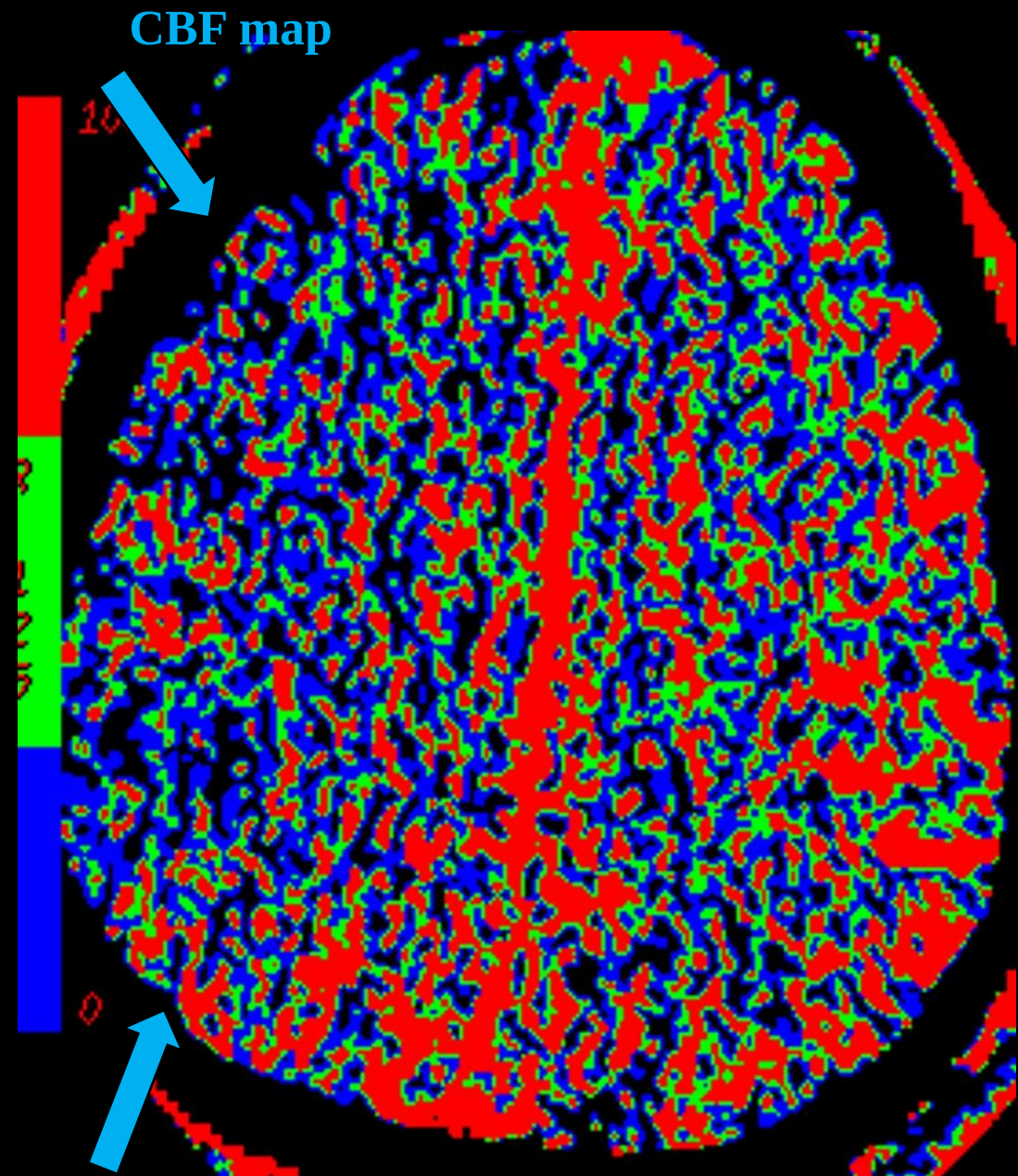
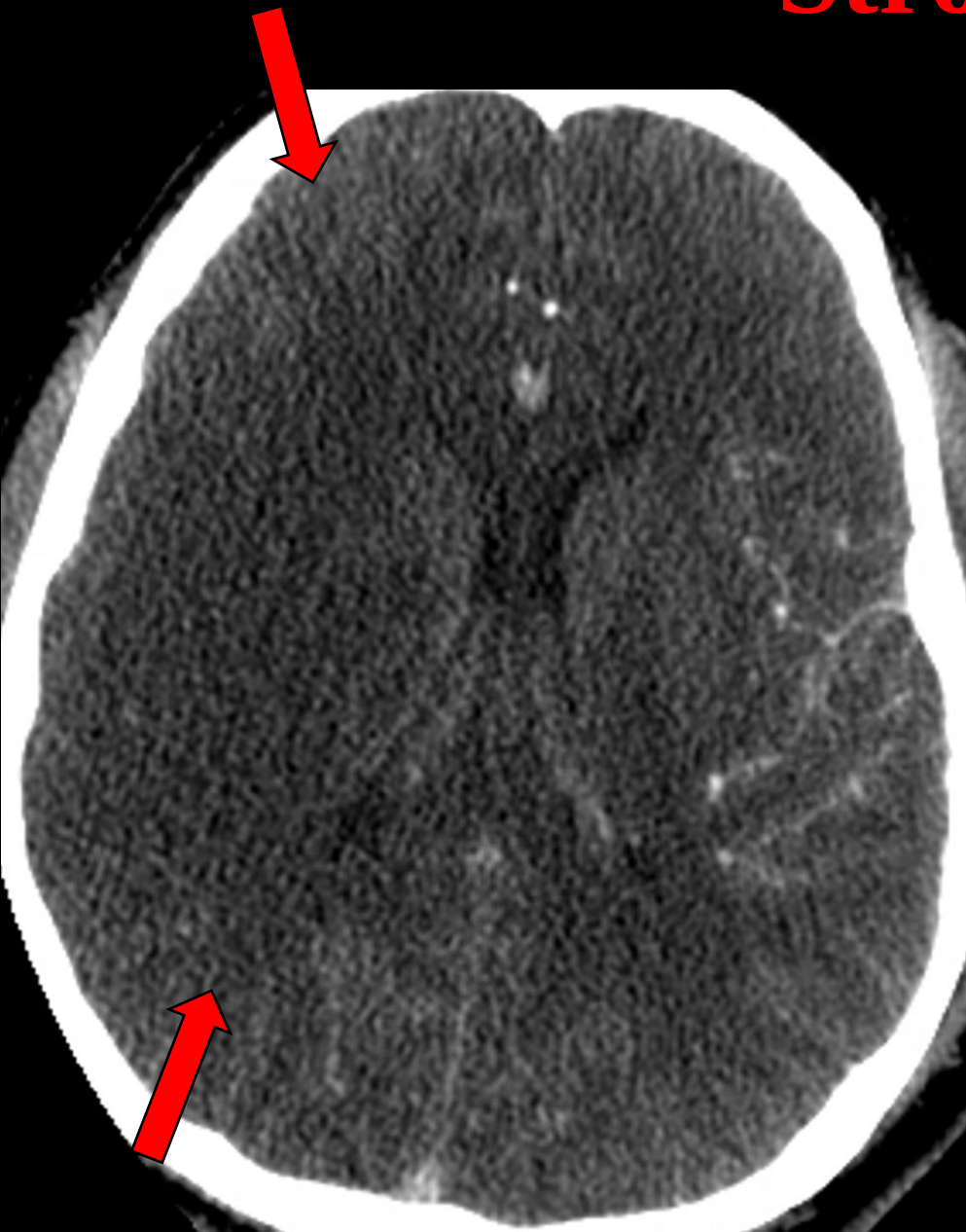
Stroke



Stroke

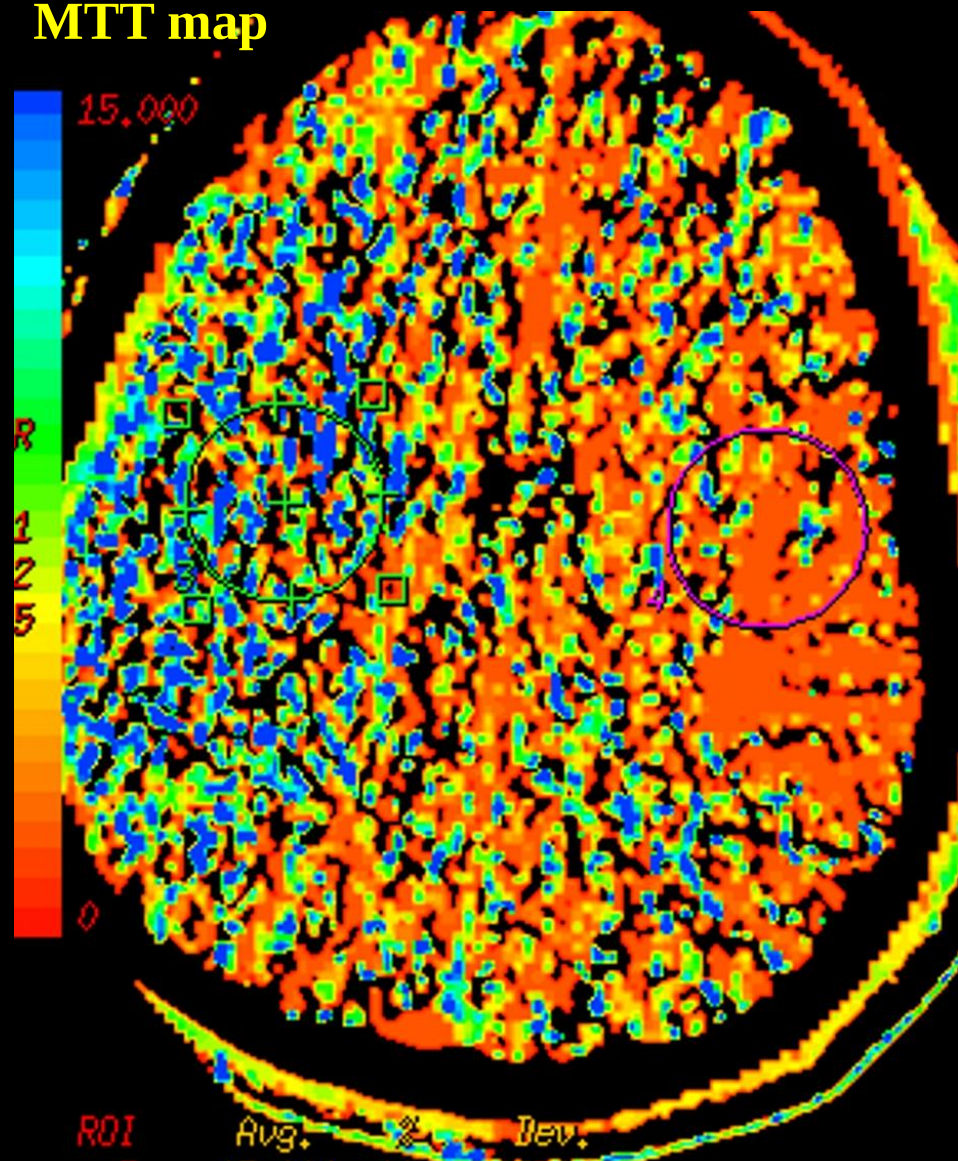


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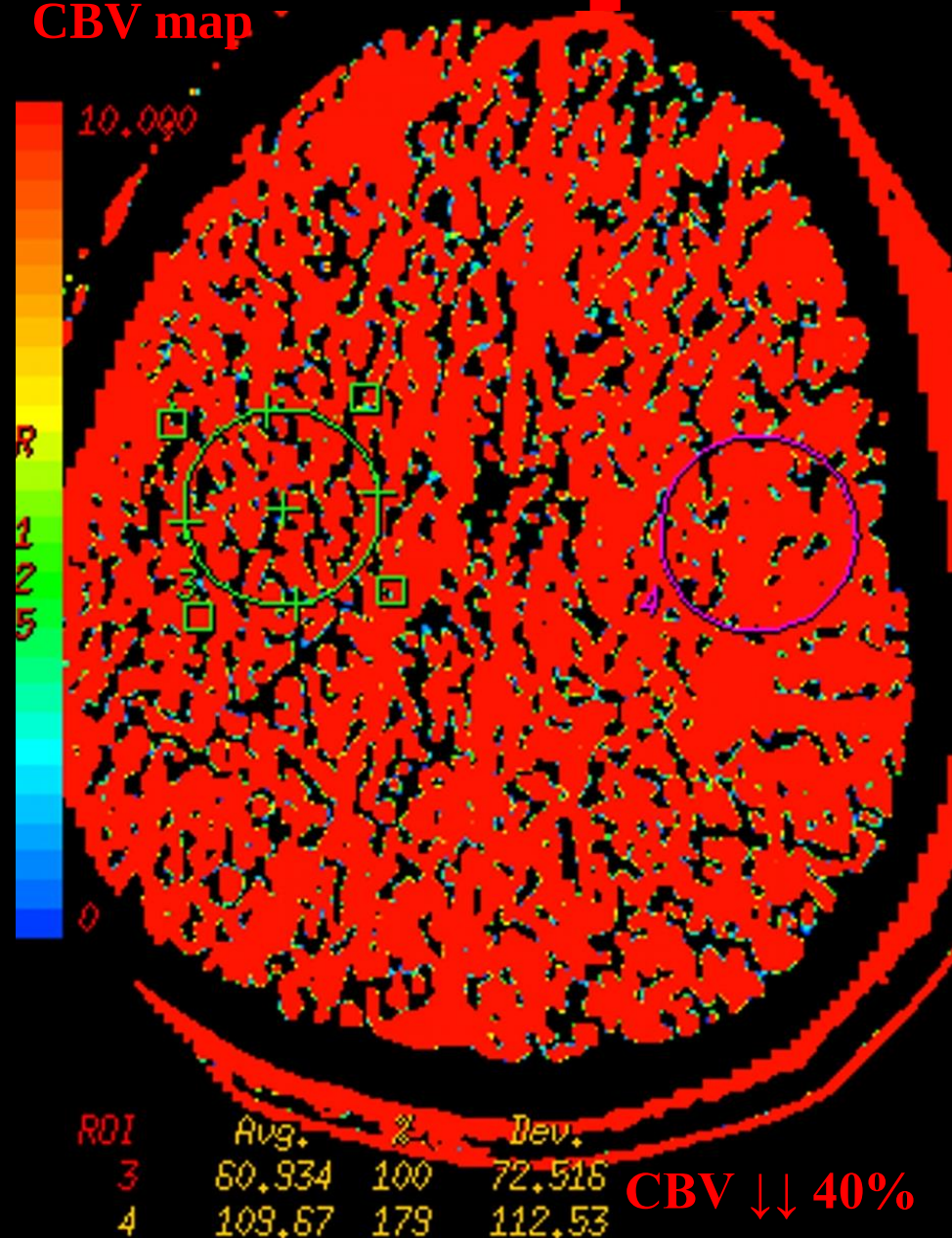
Stroke

MTT map



MTT ↑↑ 12sec

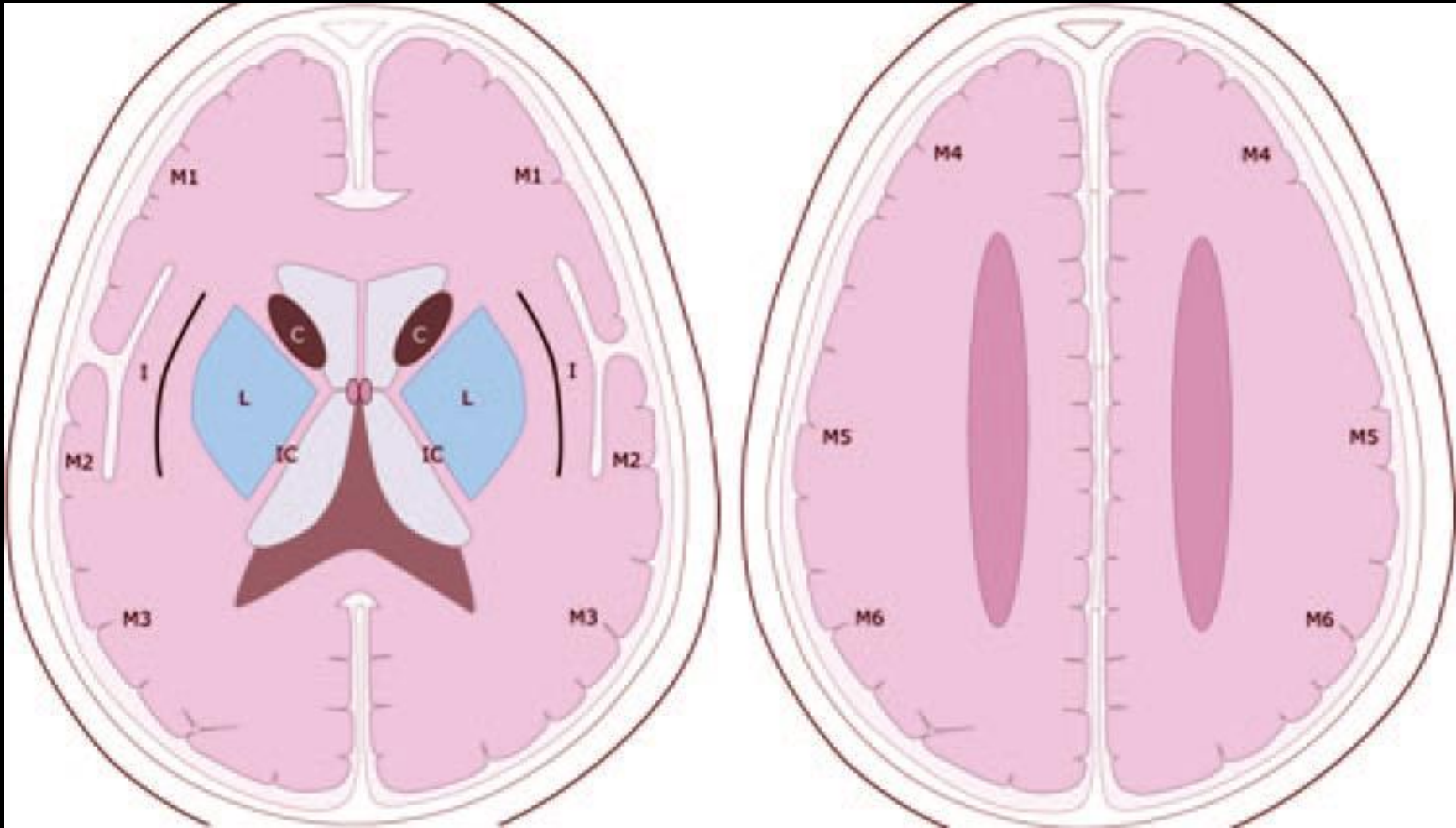
CBV map



CBV ↓↓ 40%

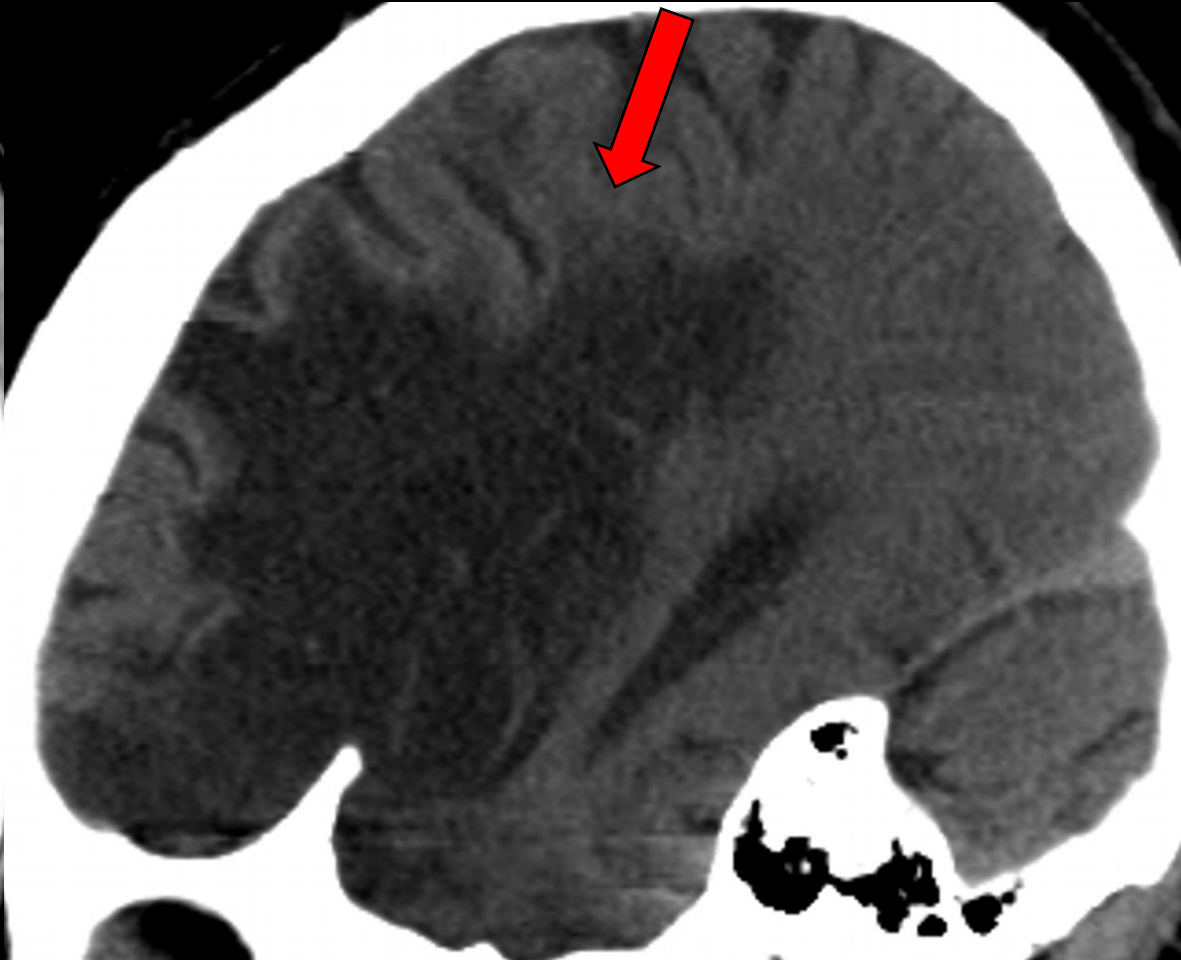
Stroke

ASPECTS System:



Aspect Score based on 10 MCA regions, 1 point assigned/region.
Cumulative score = Total 10 subtracting 1 point/region involved on C- CT

Stroke



Stroke

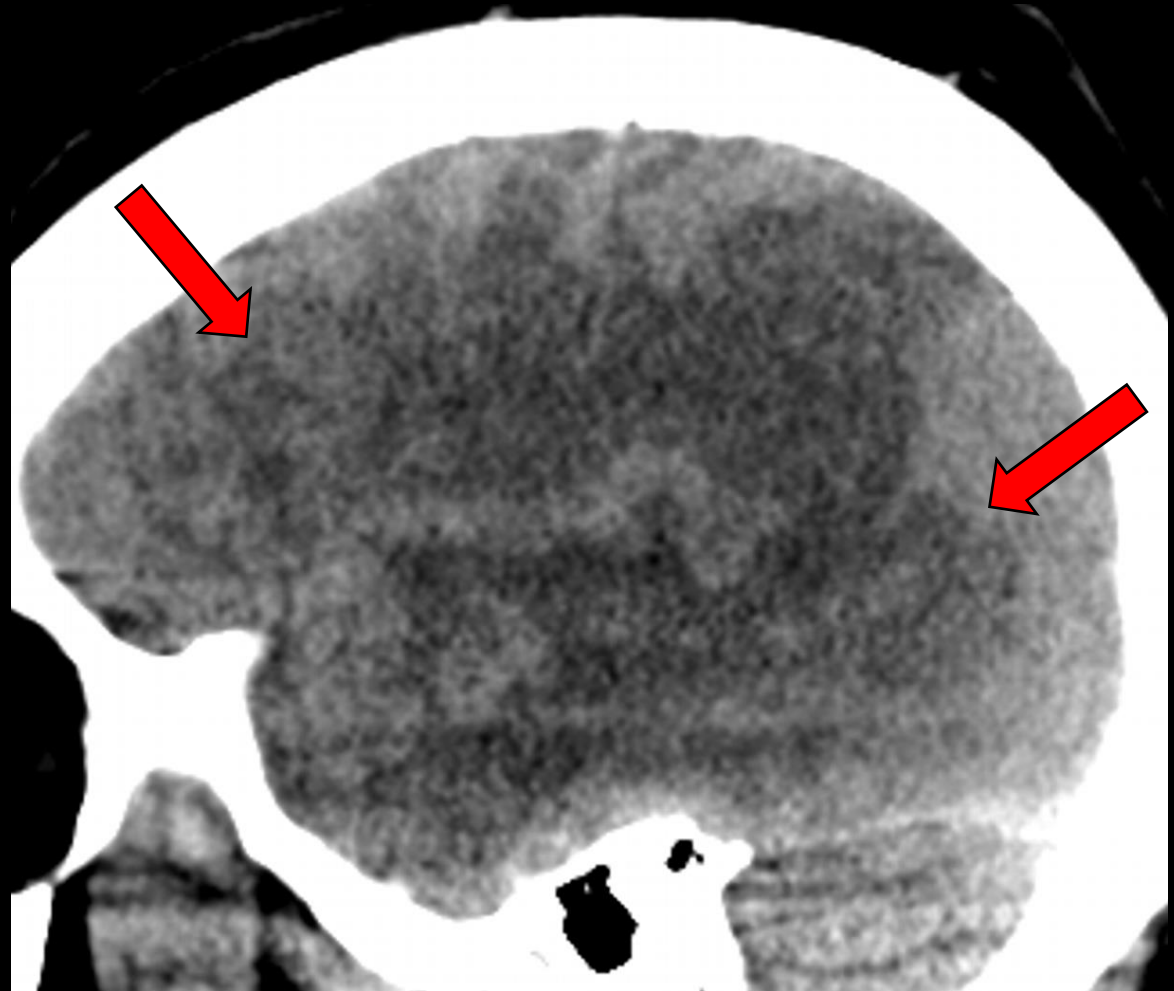
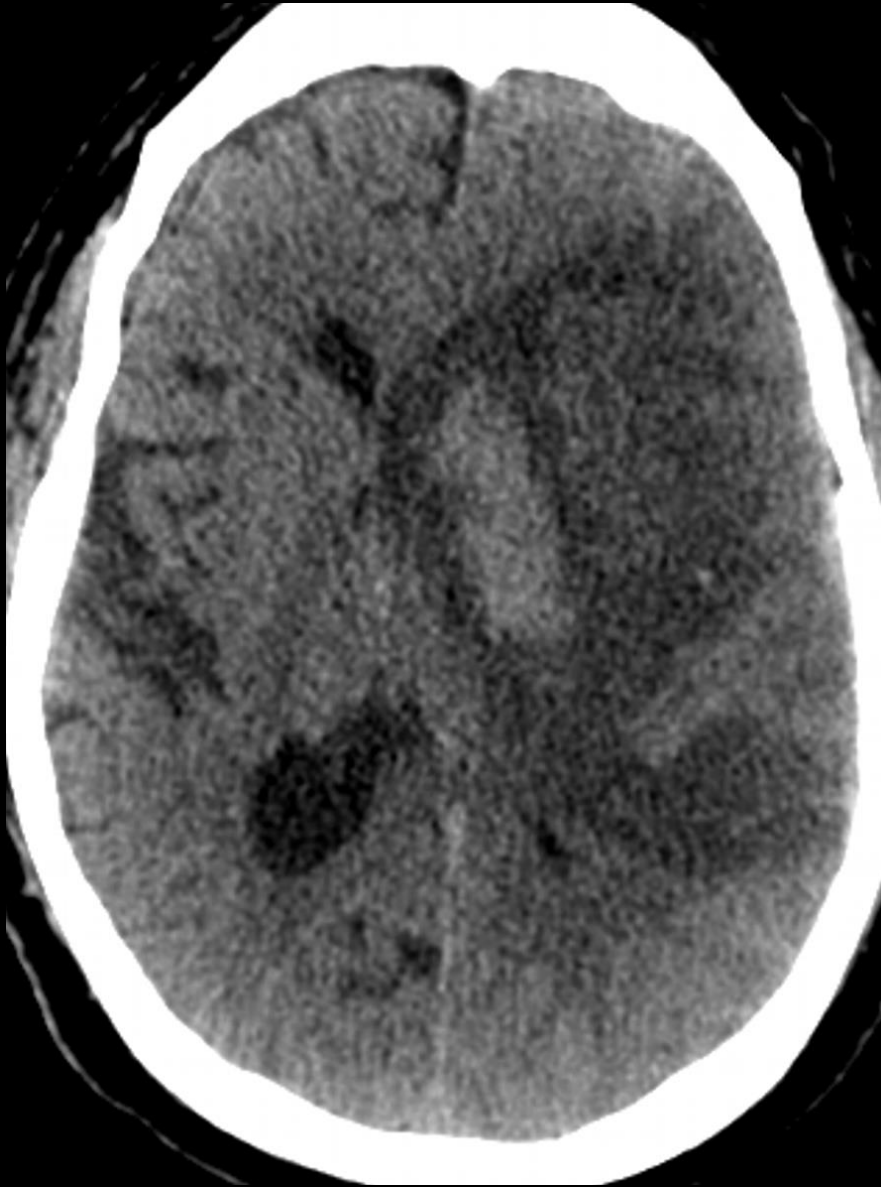


3 hr CT pre thrombolysis



24hr CT post thrombolysis malignant infarct

Stroke

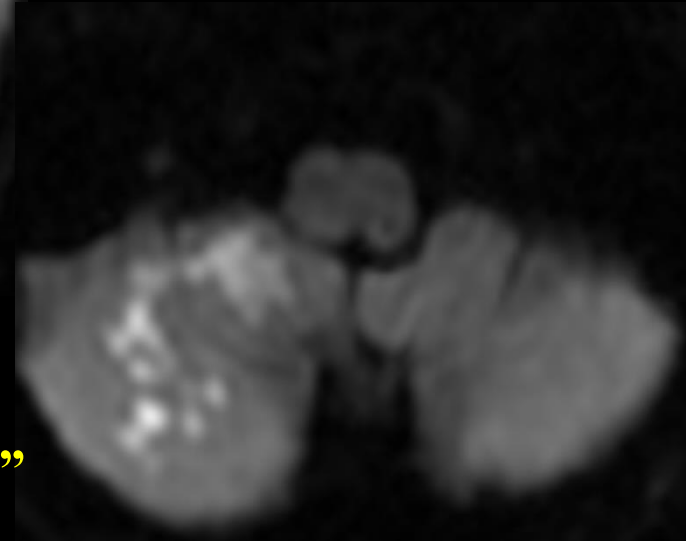
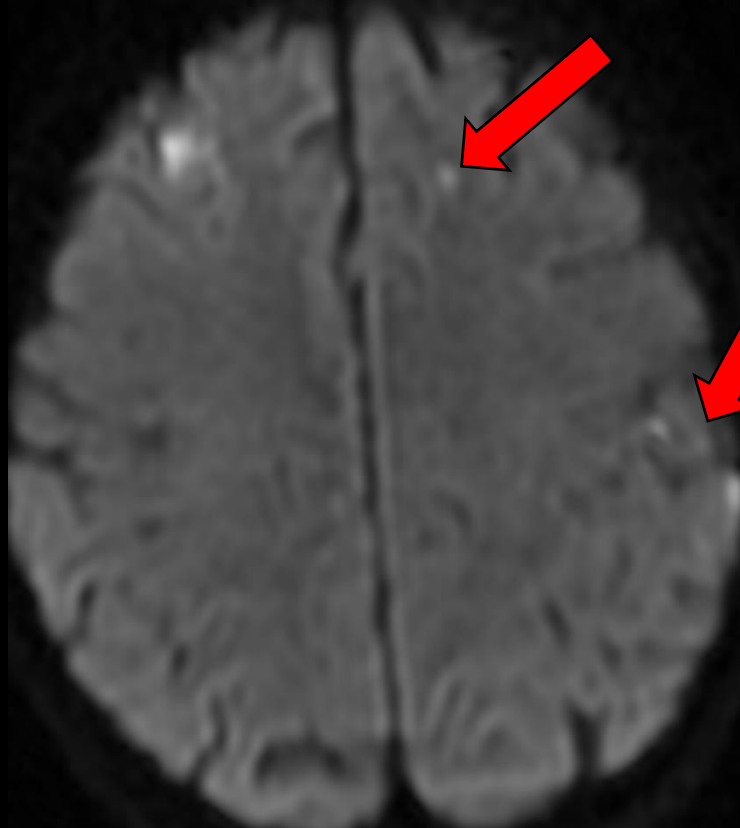
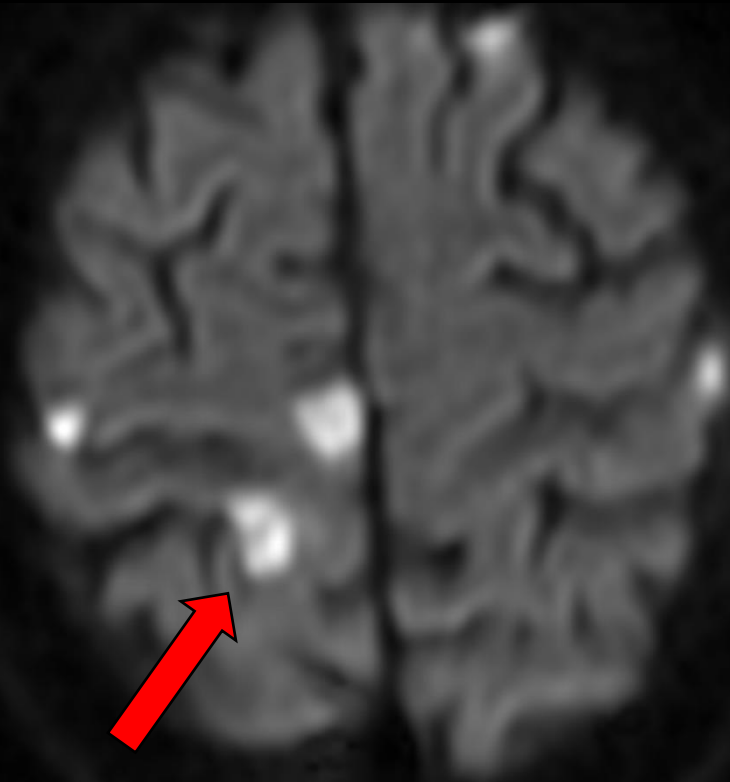


24hr CT post thrombolysis malignant infarct

Stroke Imaging

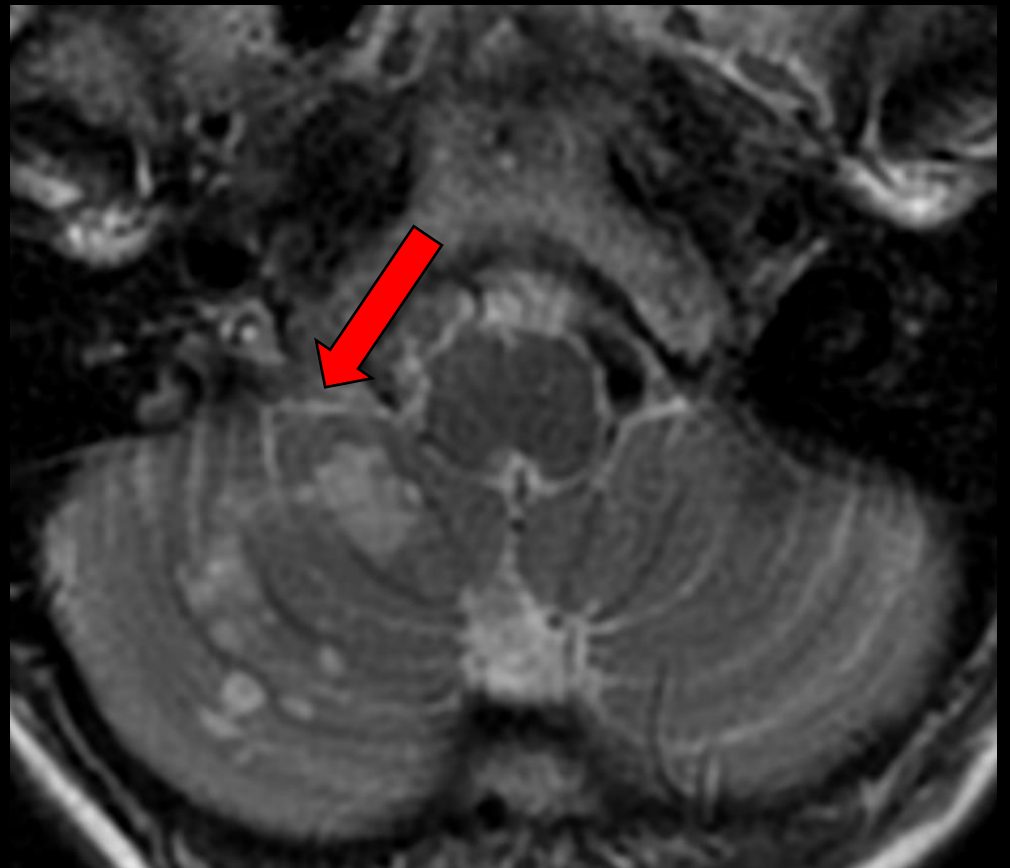
Cardioembolic infarction

Stroke



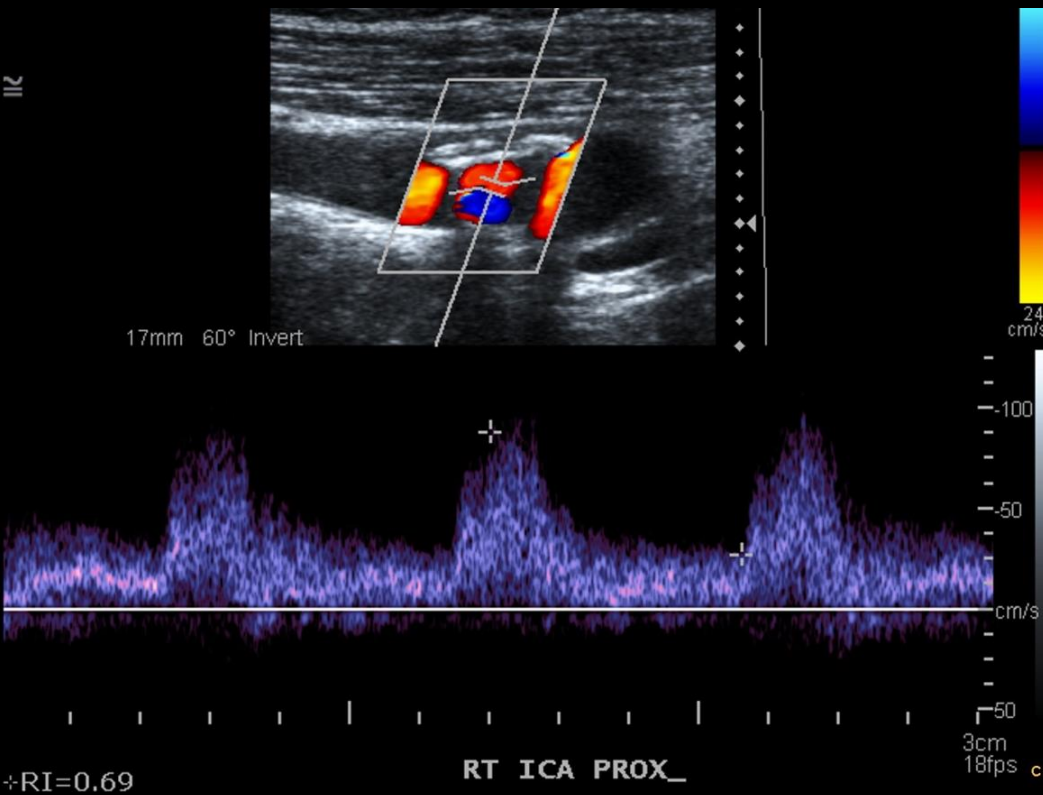
Hx cardiac surgery, ataxic, R hemiparesis”

Stroke

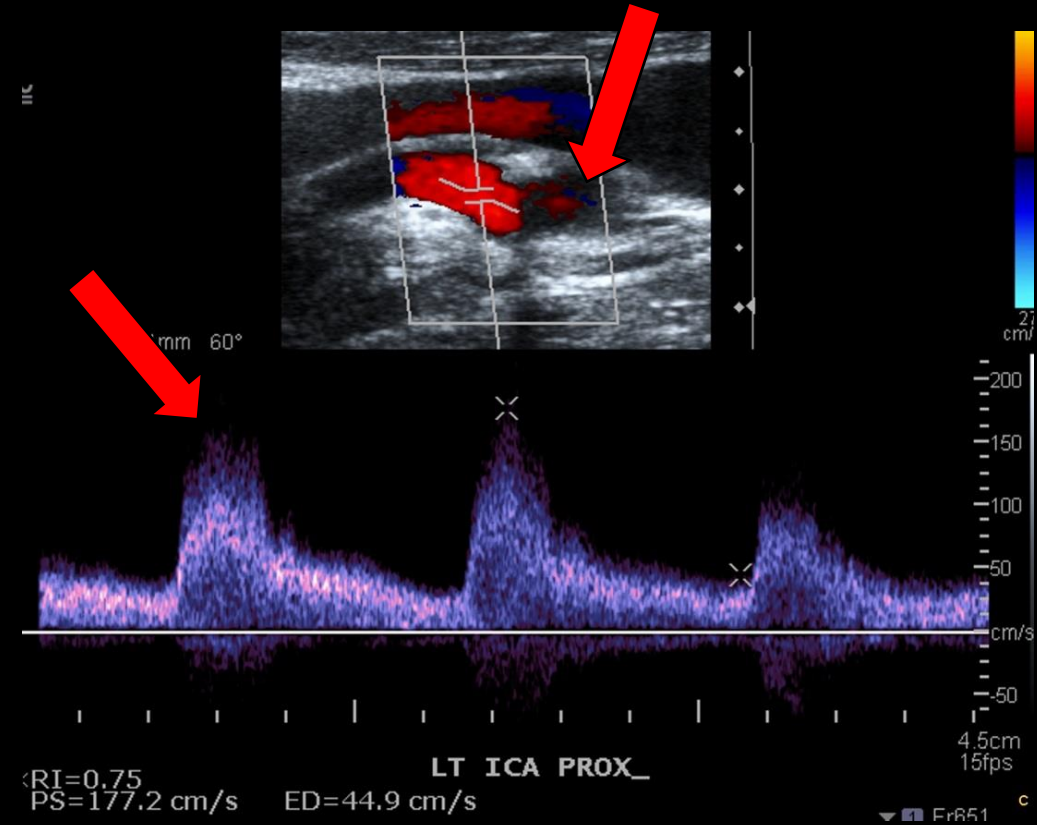


Hx cardiac surgery, ataxic, R hemiparesis”

Stroke



R ICA stenosis < 30%



L ICA stenosis 60-69%

Stroke

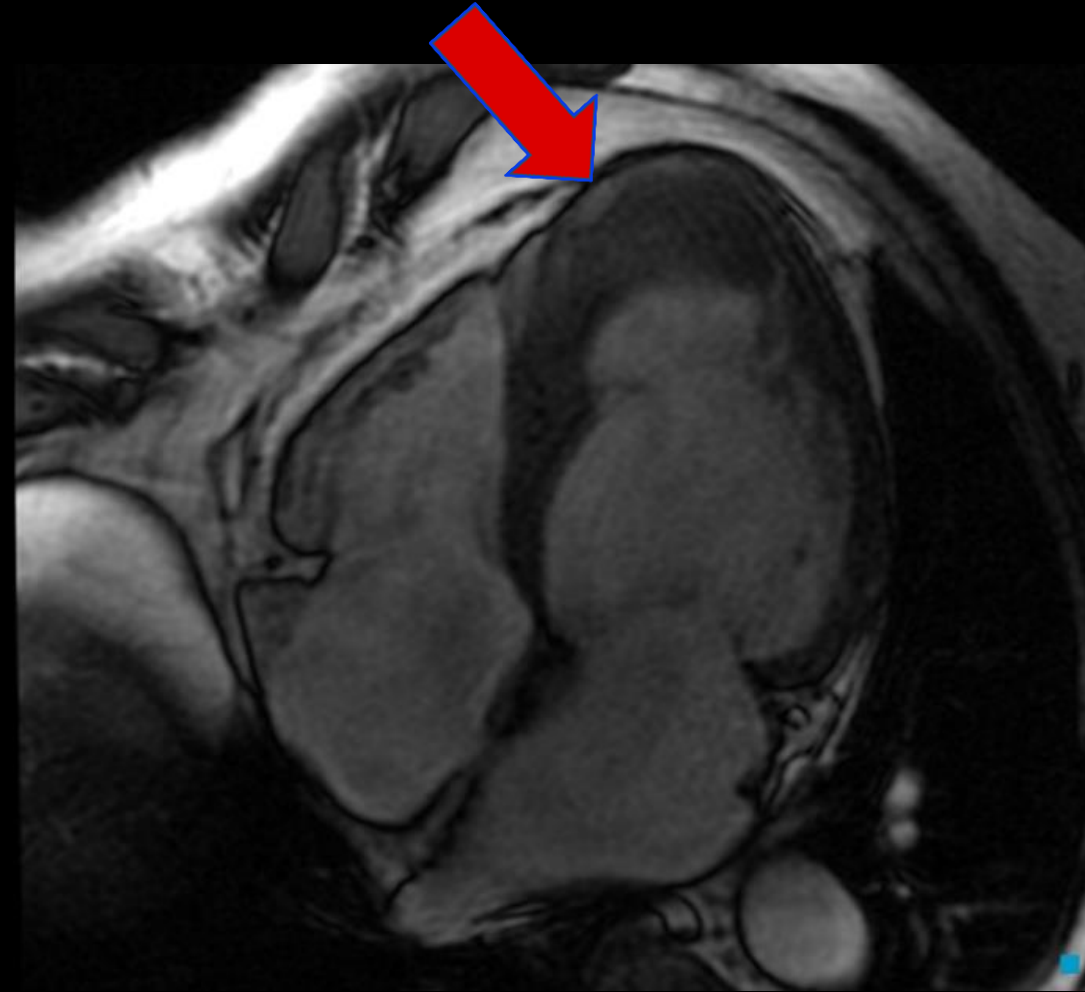


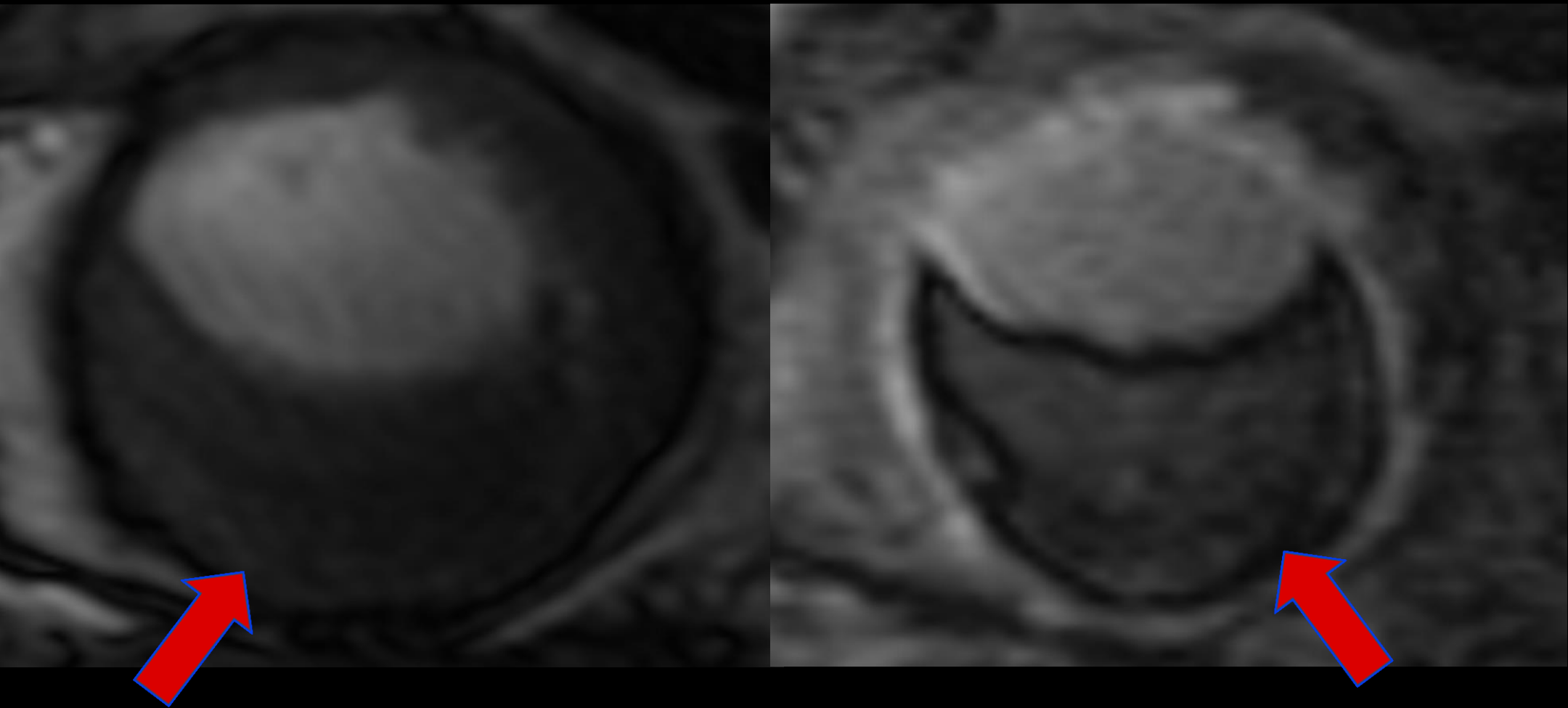
Figure 1 (Fiesta)



Figure 2 (MDE)

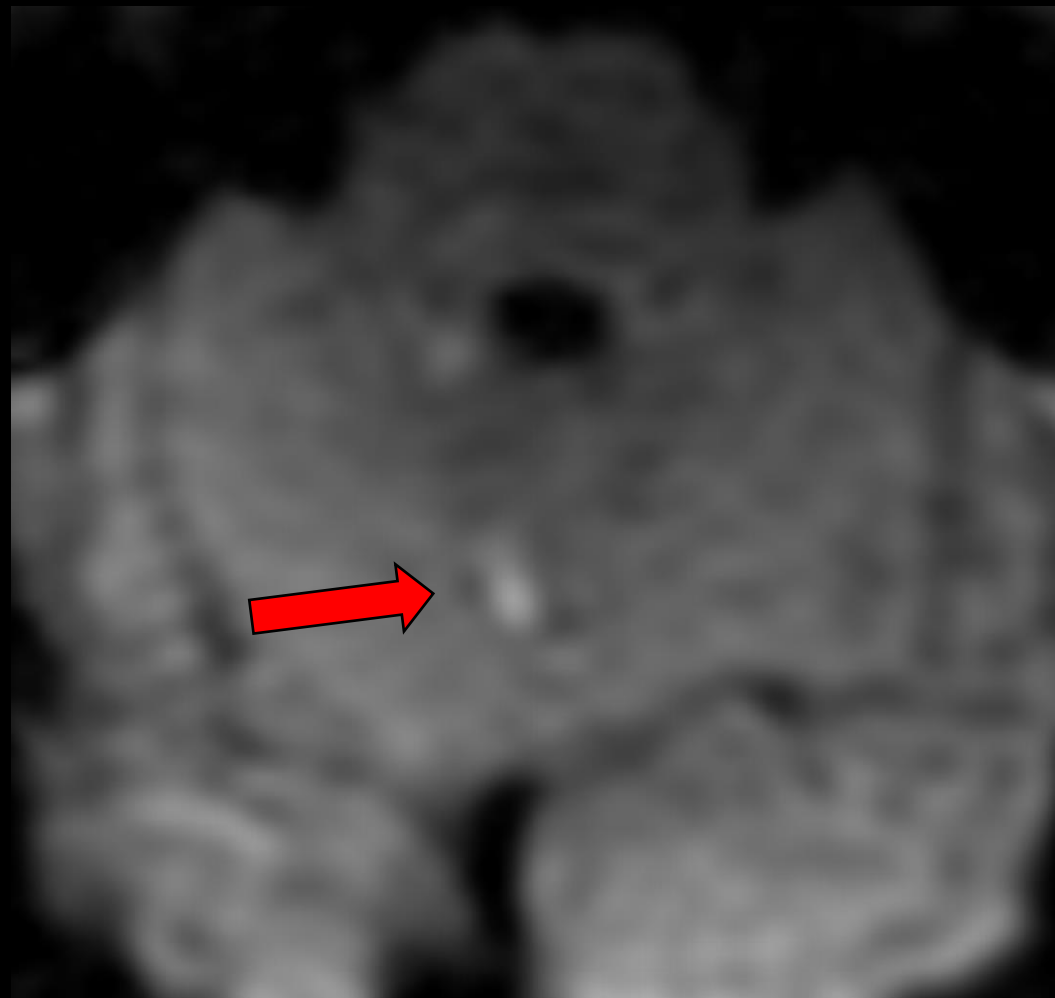
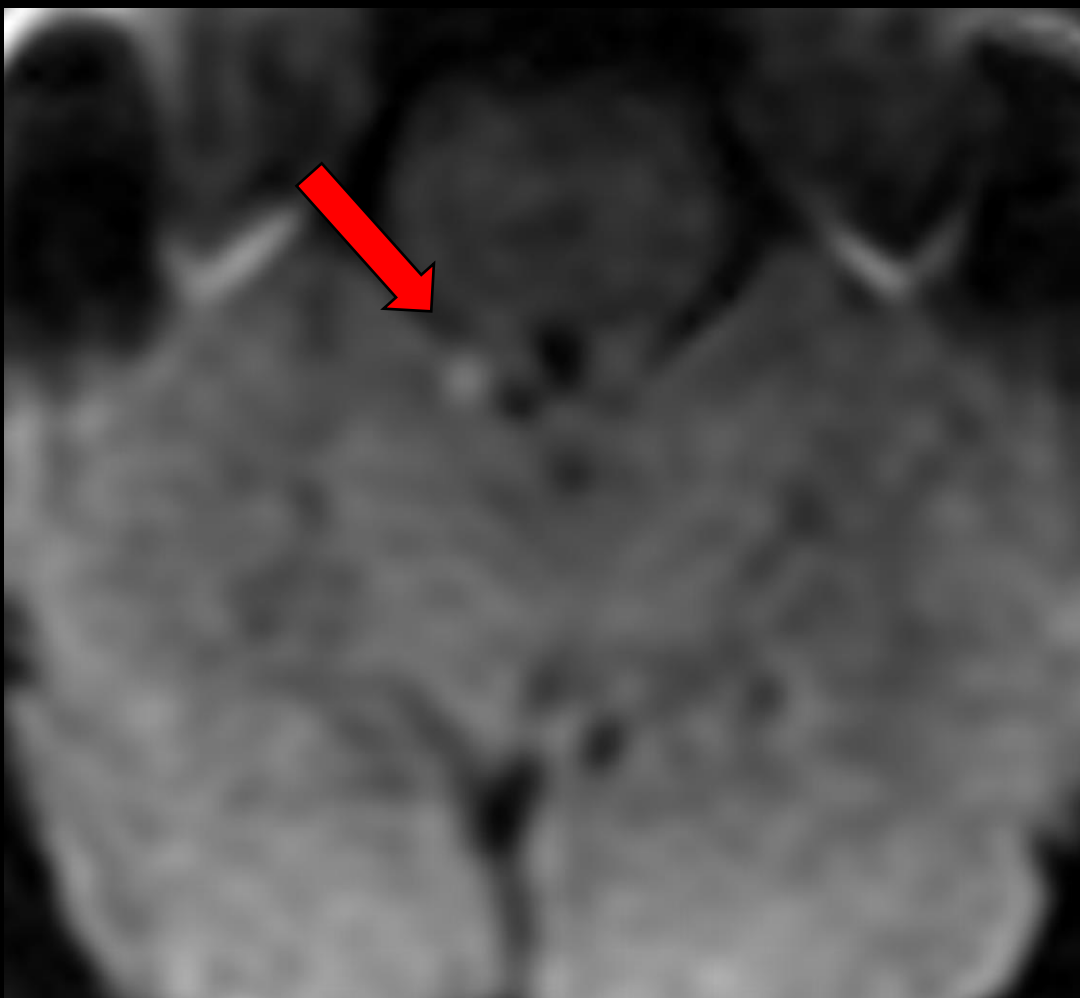
Hx cardiac surgery. MR embolic infarcts. Echo “apical hypokinesis”

Stroke



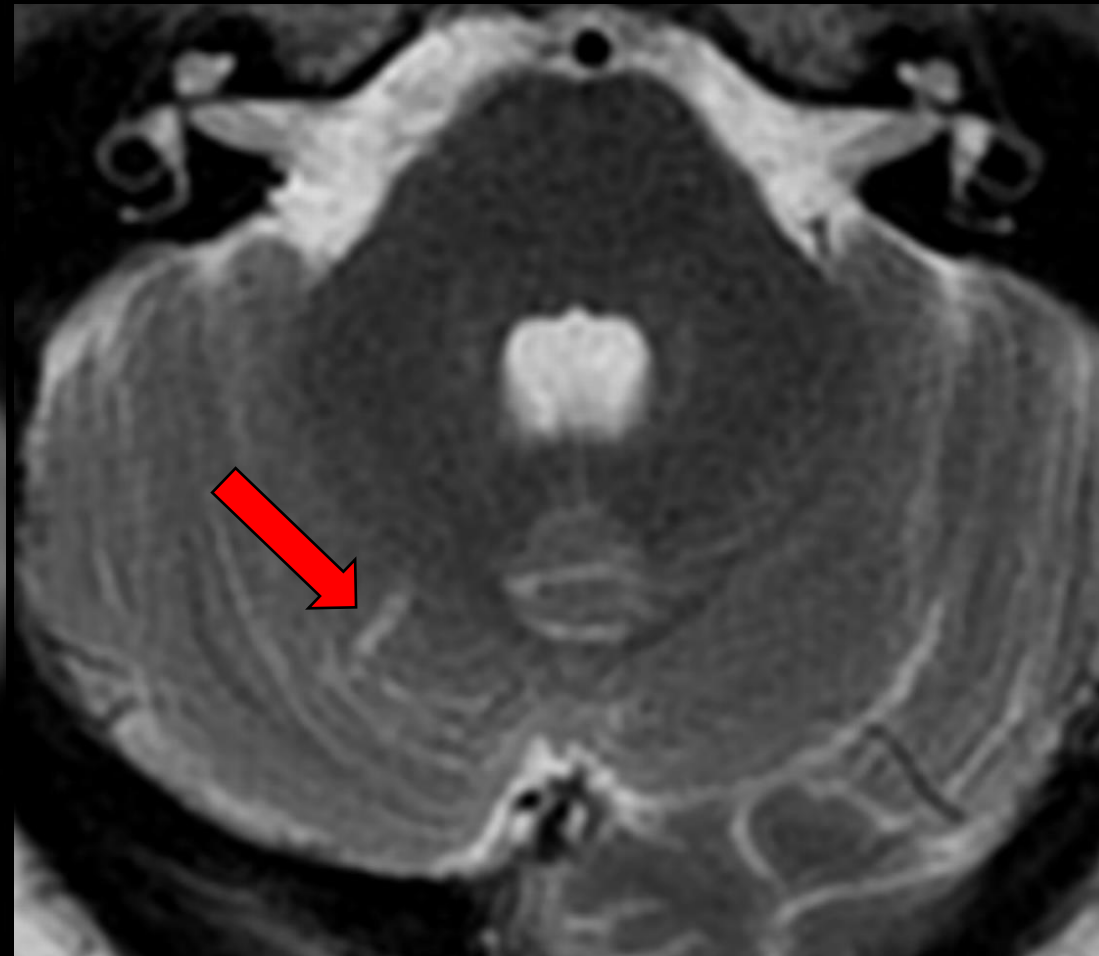
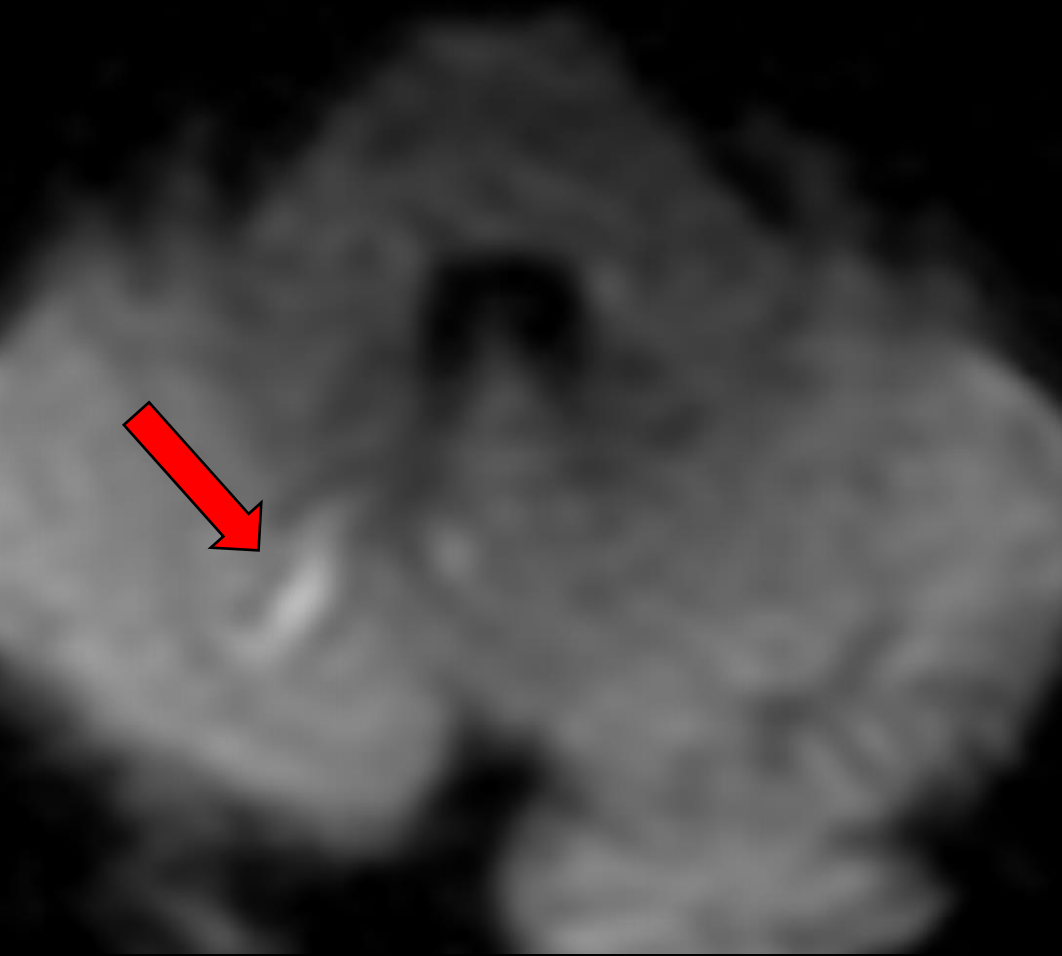
Hx cardiac surgery. MR embolic infarcts. Echo “apical hypokinesis”

Stroke



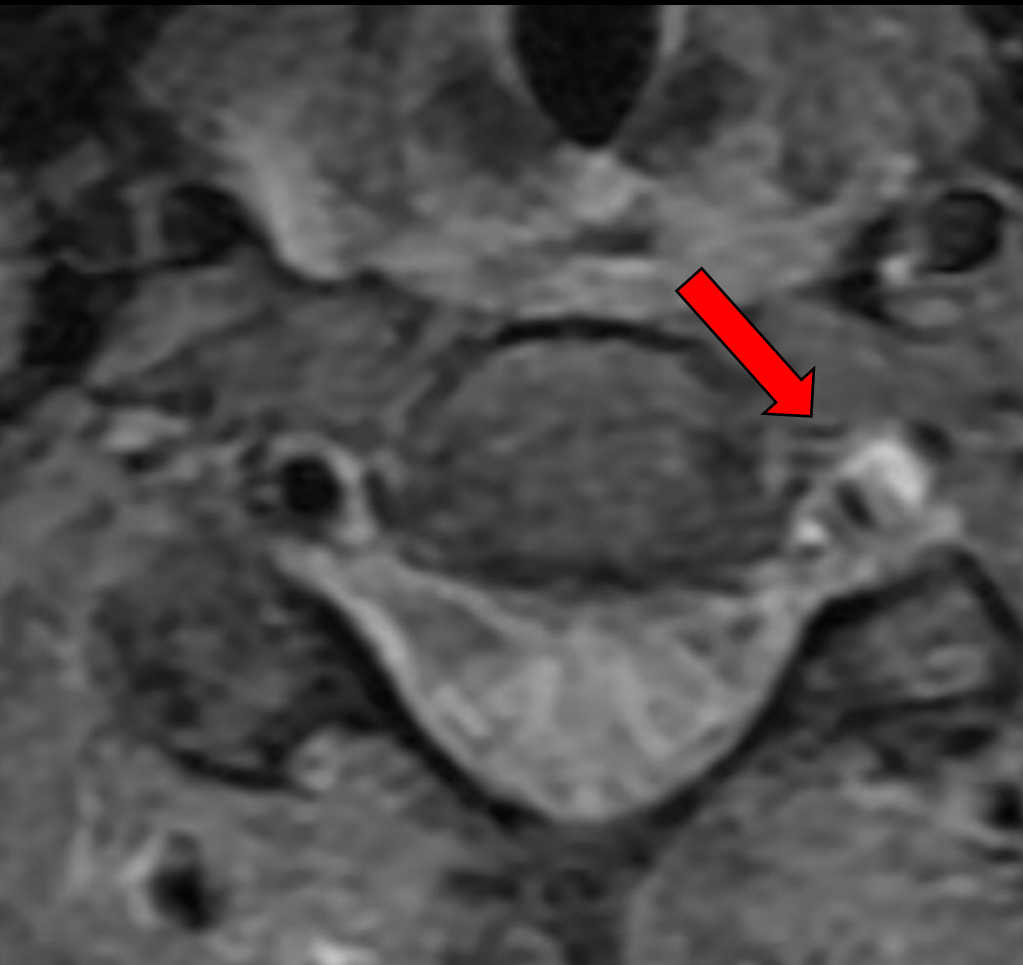
F35 left neck pain and ataxia

Stroke



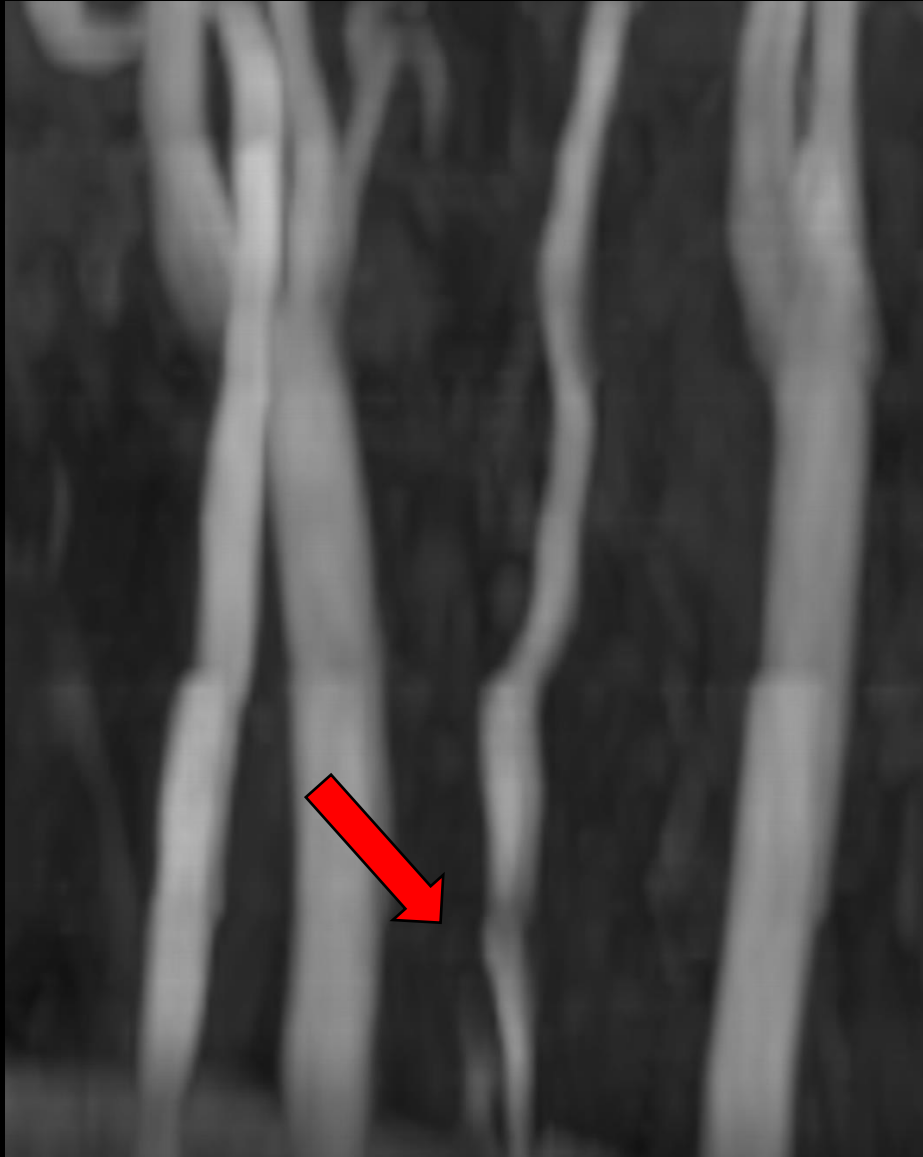
F35 left neck pain and ataxia

Stroke



F35 left neck pain and ataxia

Stroke



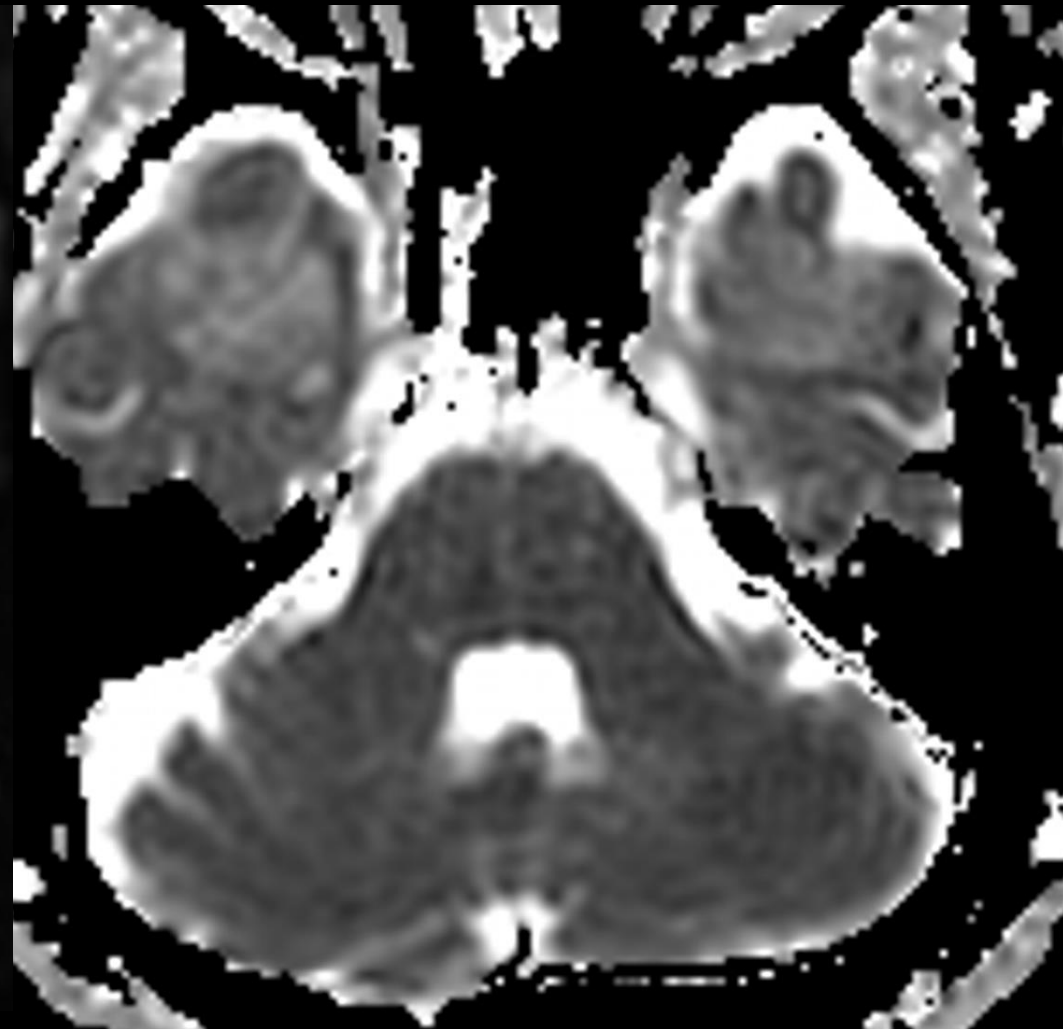
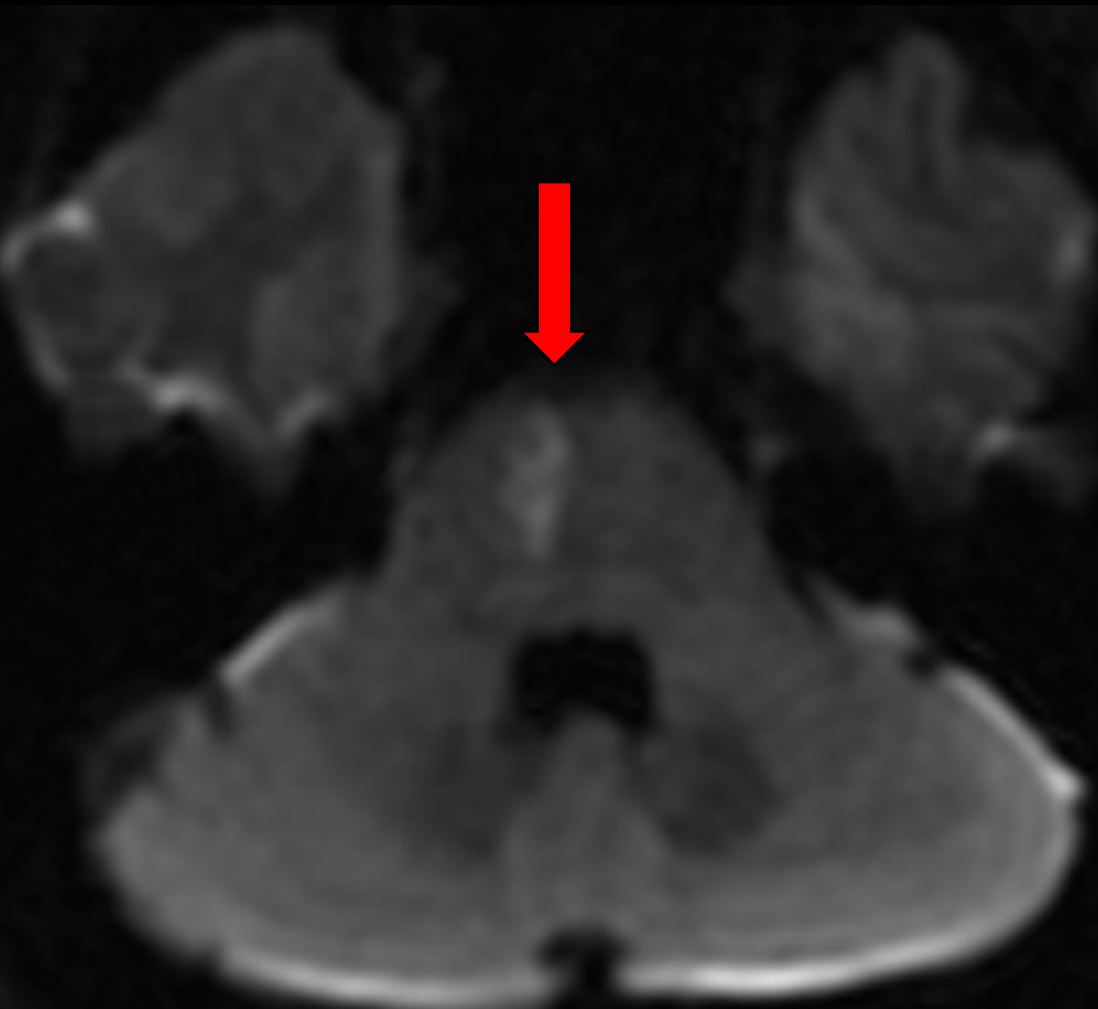
F35 left neck pain and ataxia

Stroke Imaging

Lacunar infarction

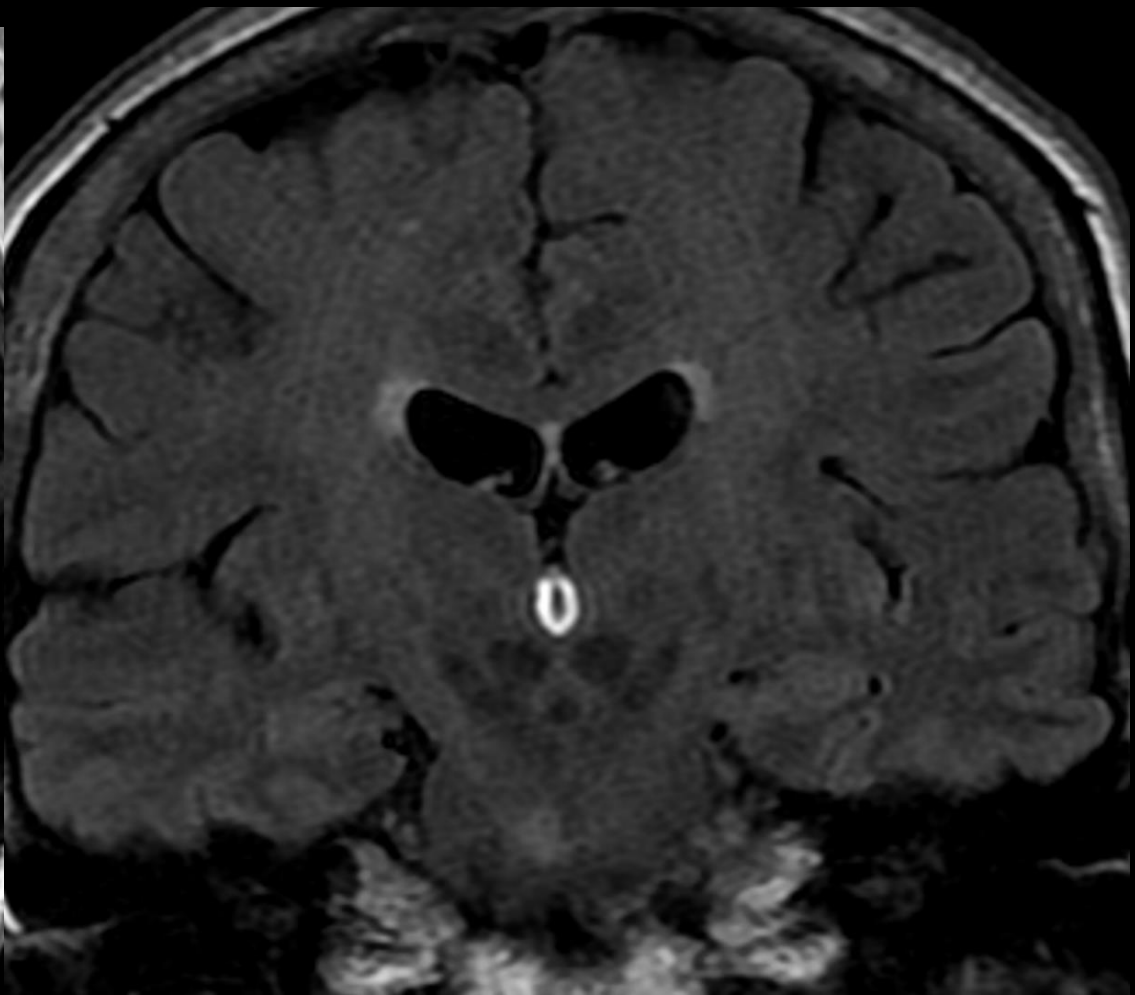
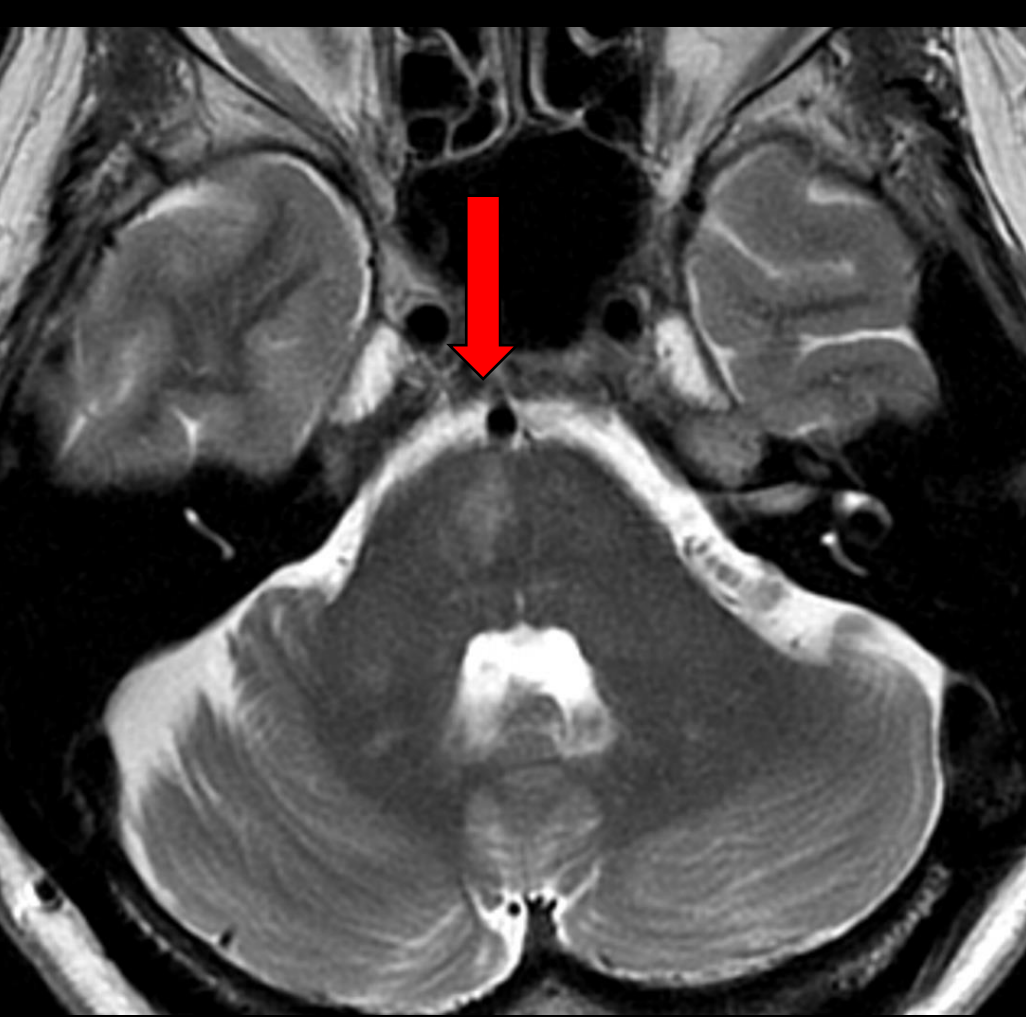
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Stroke Imaging



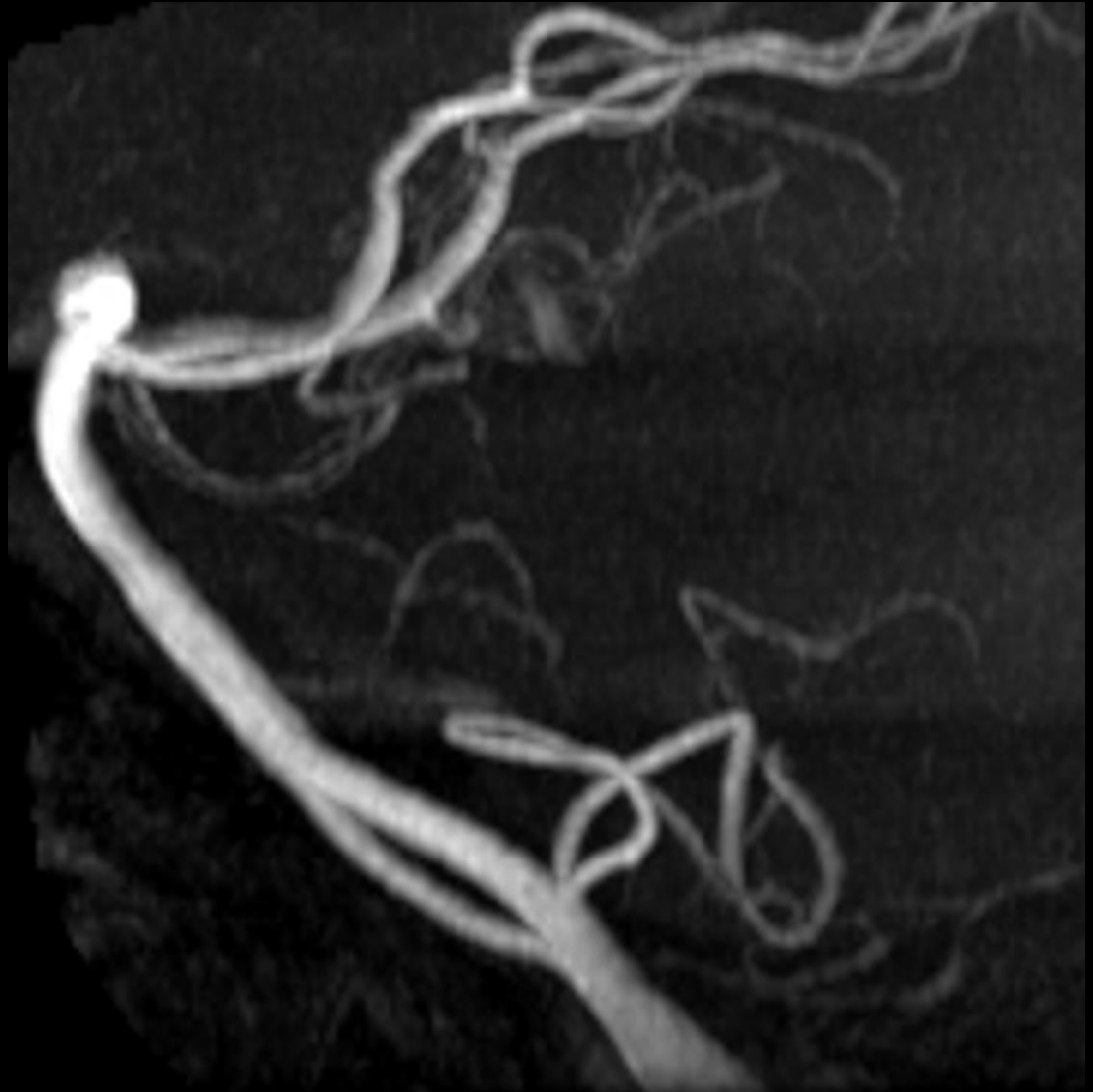
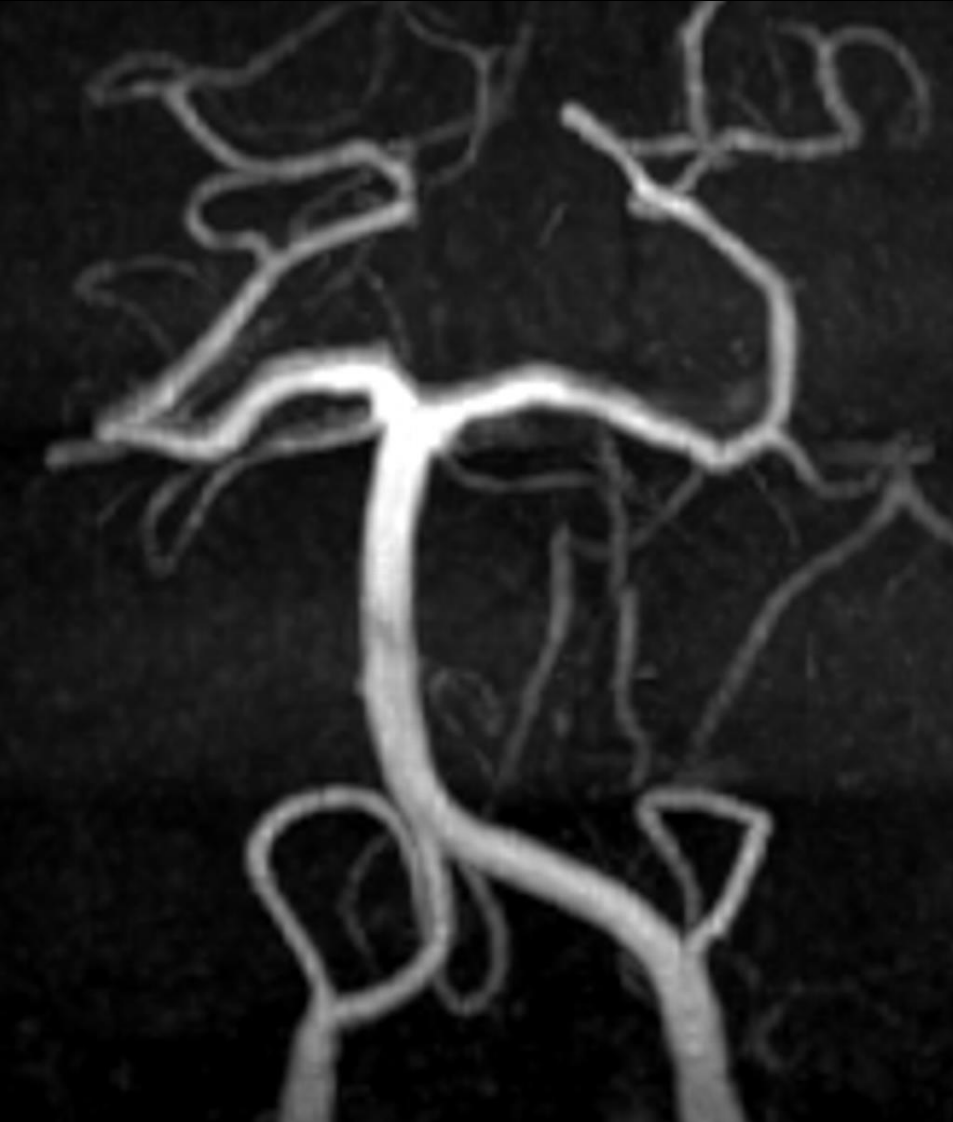
F77yr acute L mild facial weakness

Stroke Imaging



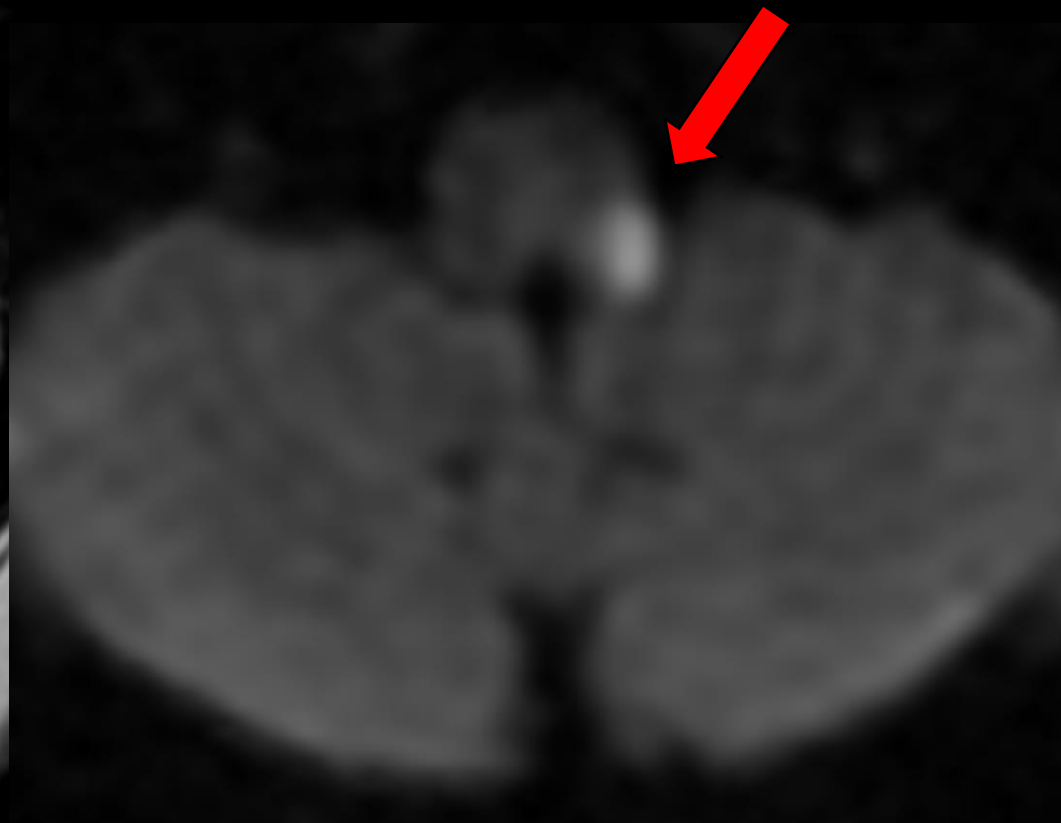
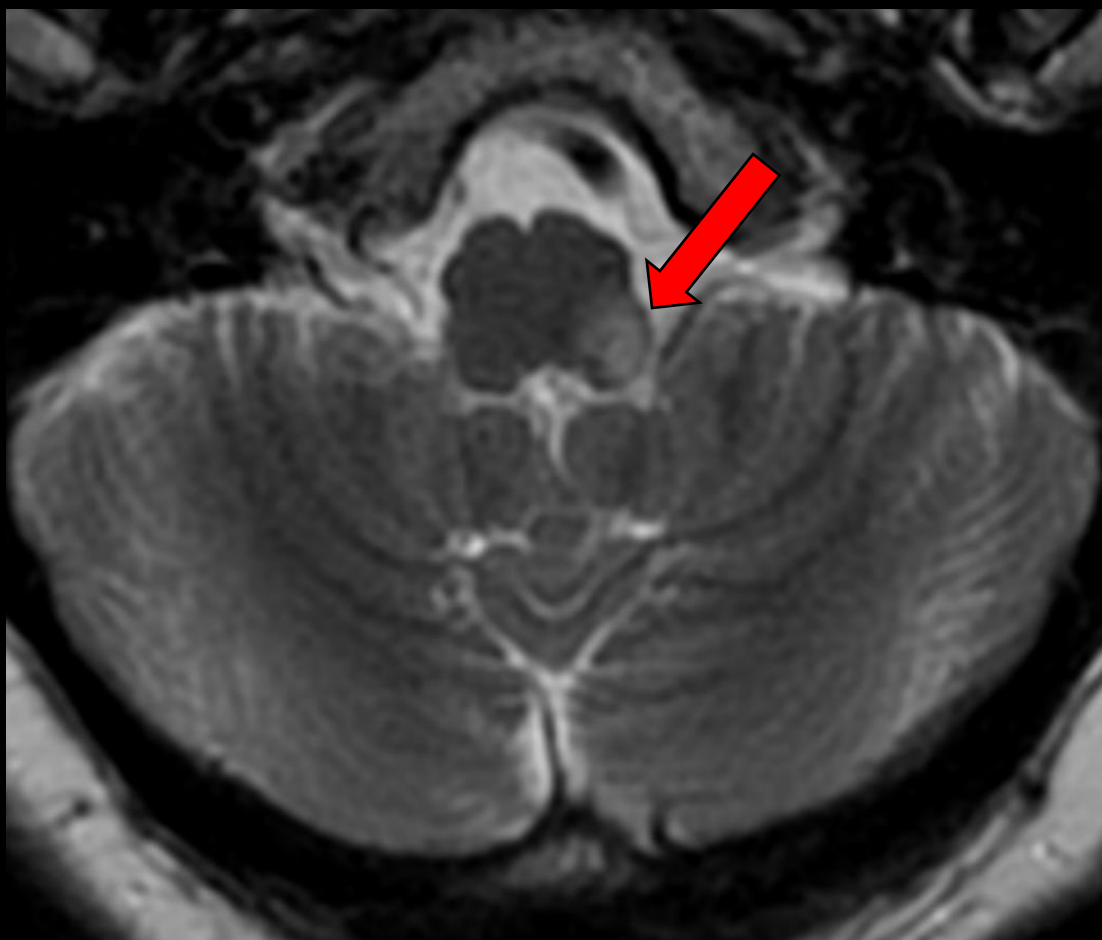
F77yr acute L mild facial weakness

Stroke Imaging



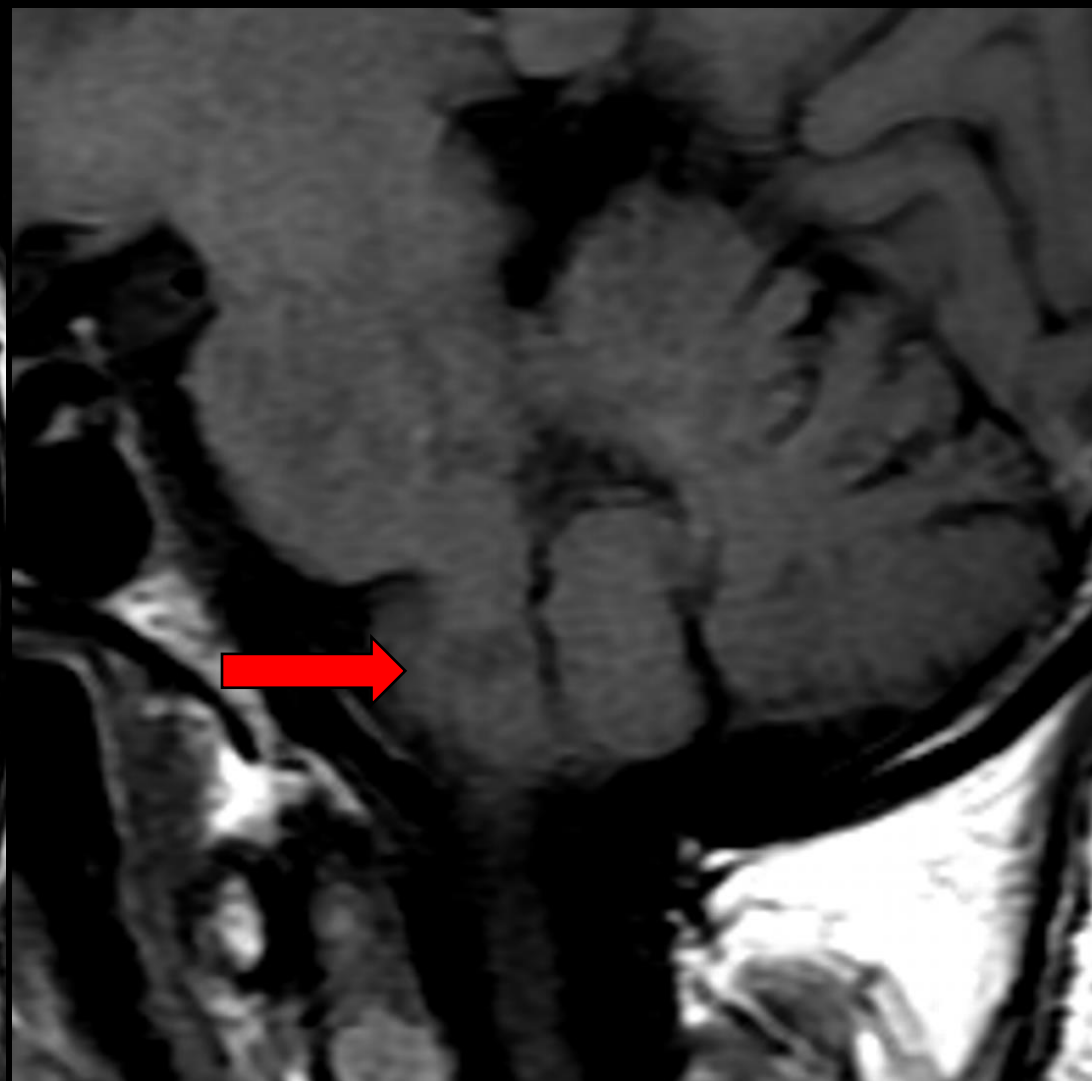
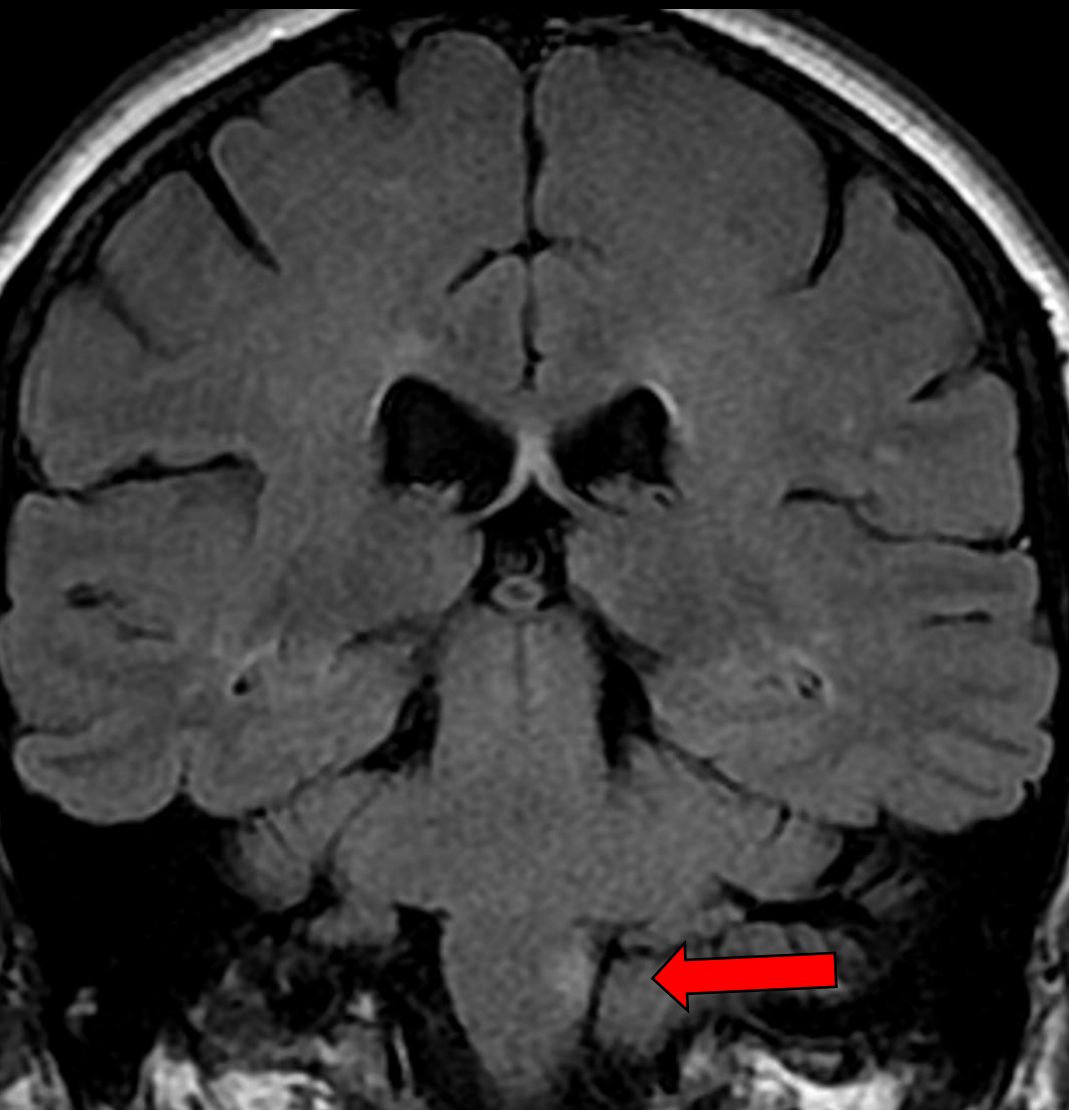
F77yr acute L mild facial weakness

Stroke



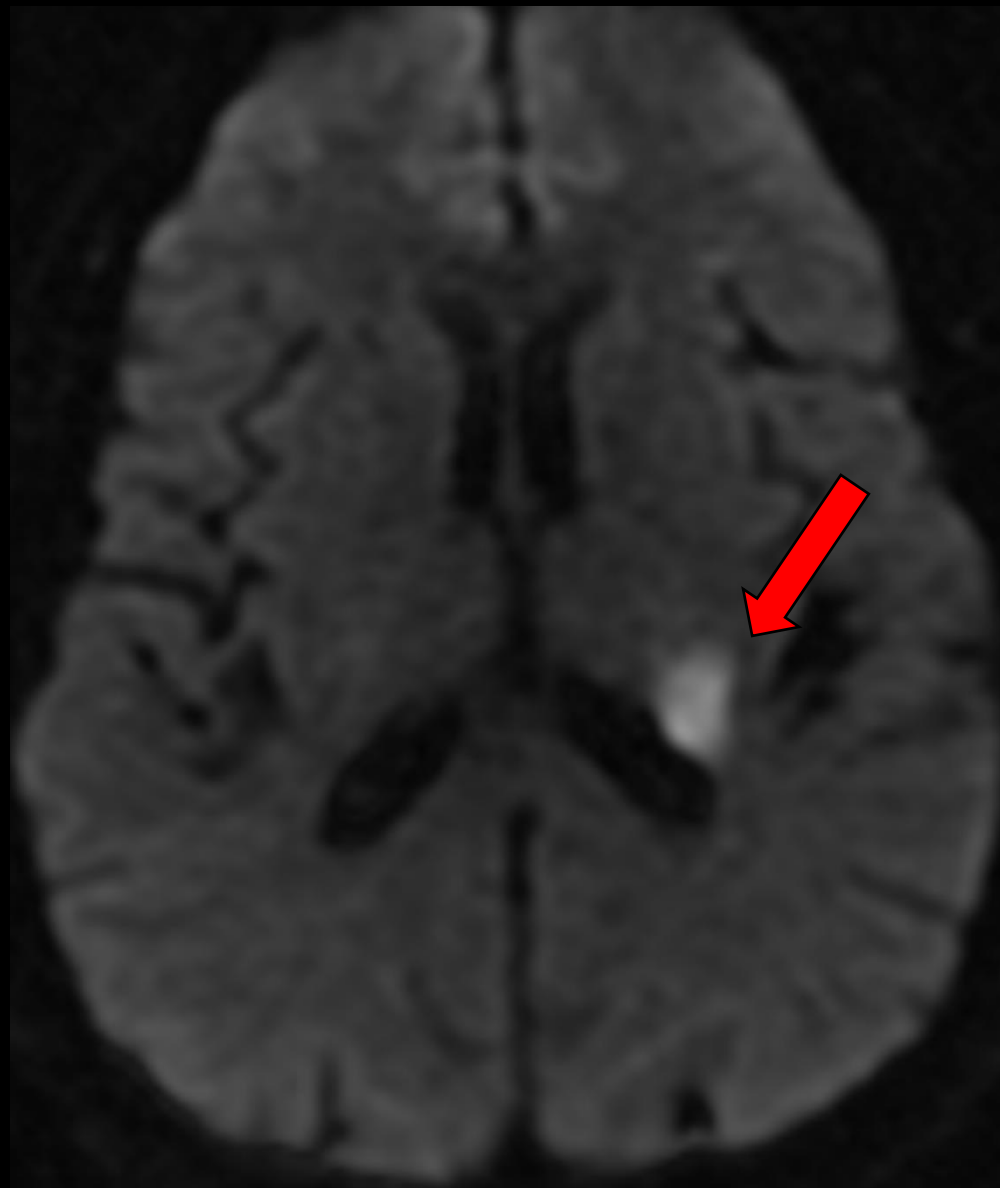
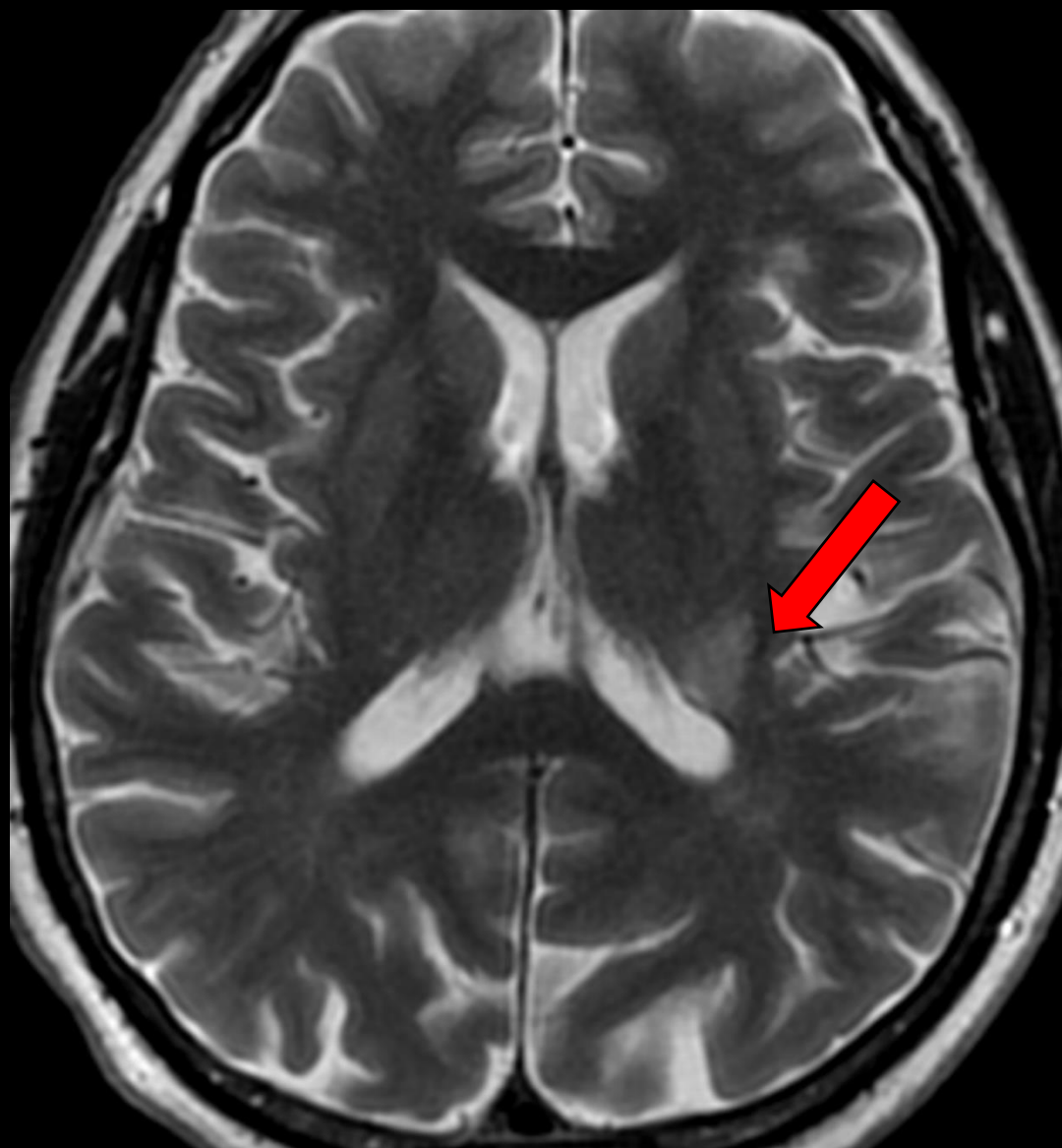
F61yr acute rotatory nystagmus, nausea-vomiting

Stroke



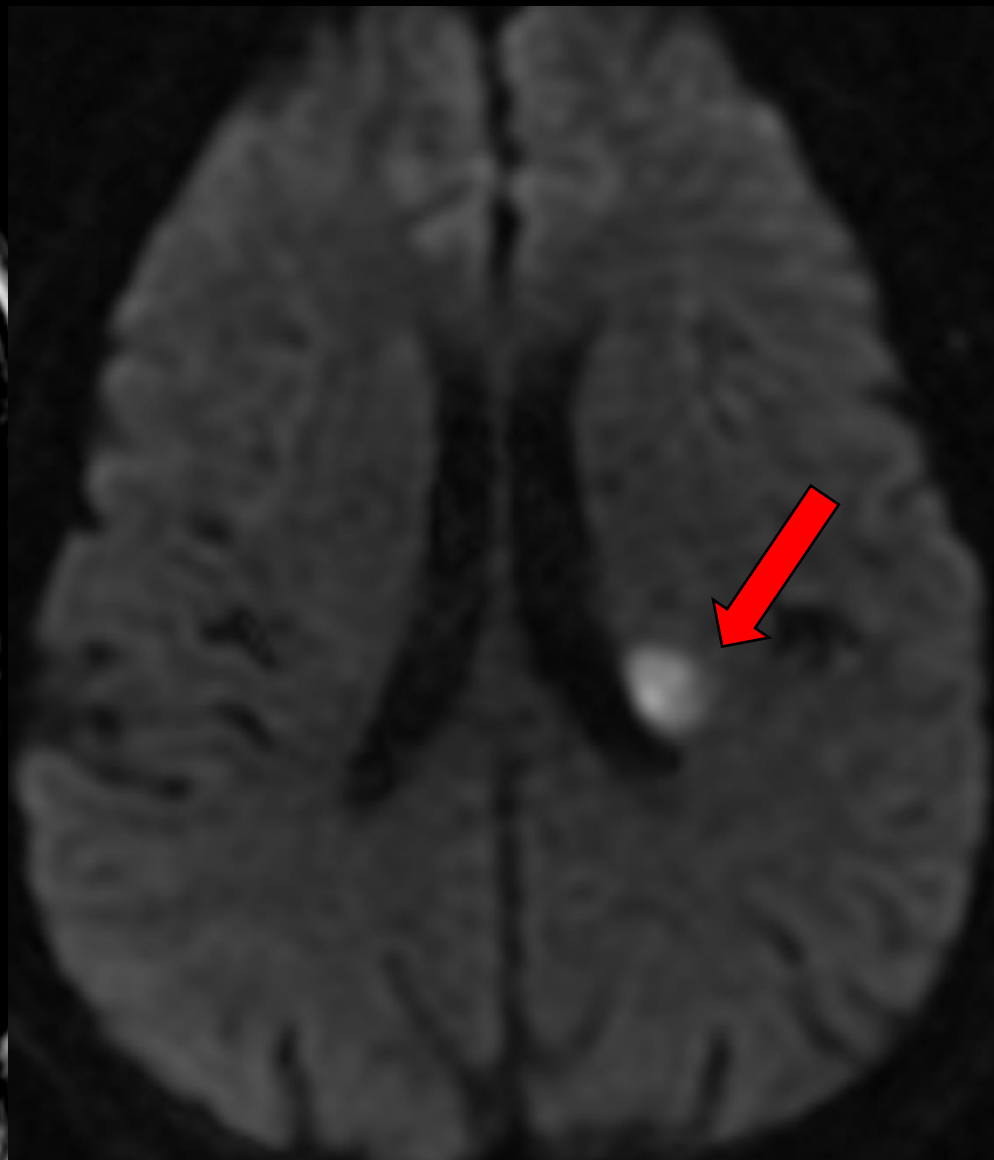
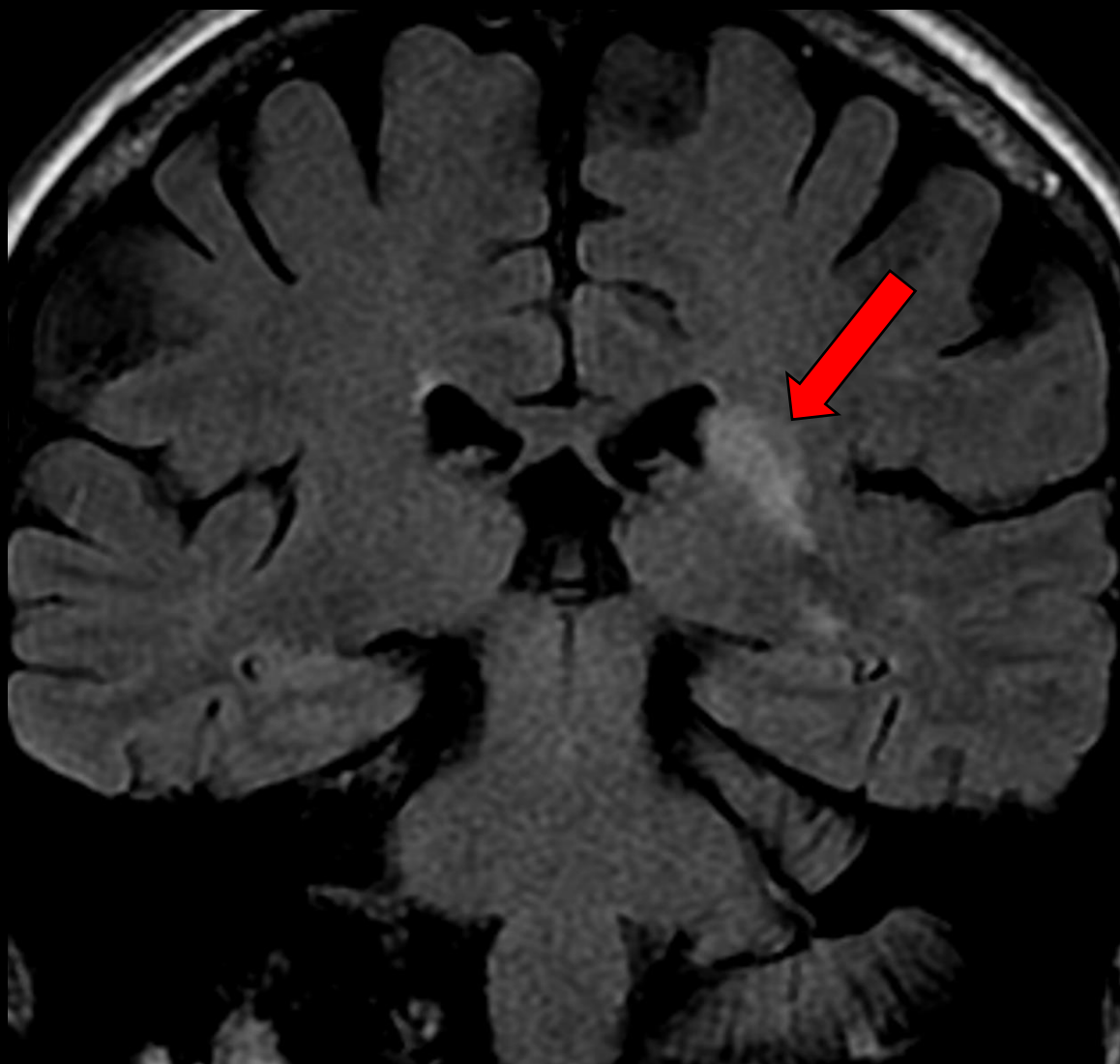
F61yr acute rotatory nystagmus, nausea-vomiting, L facial sensory Δ

Stroke



M66yr acute onset R leg weakness, CT normal

Stroke



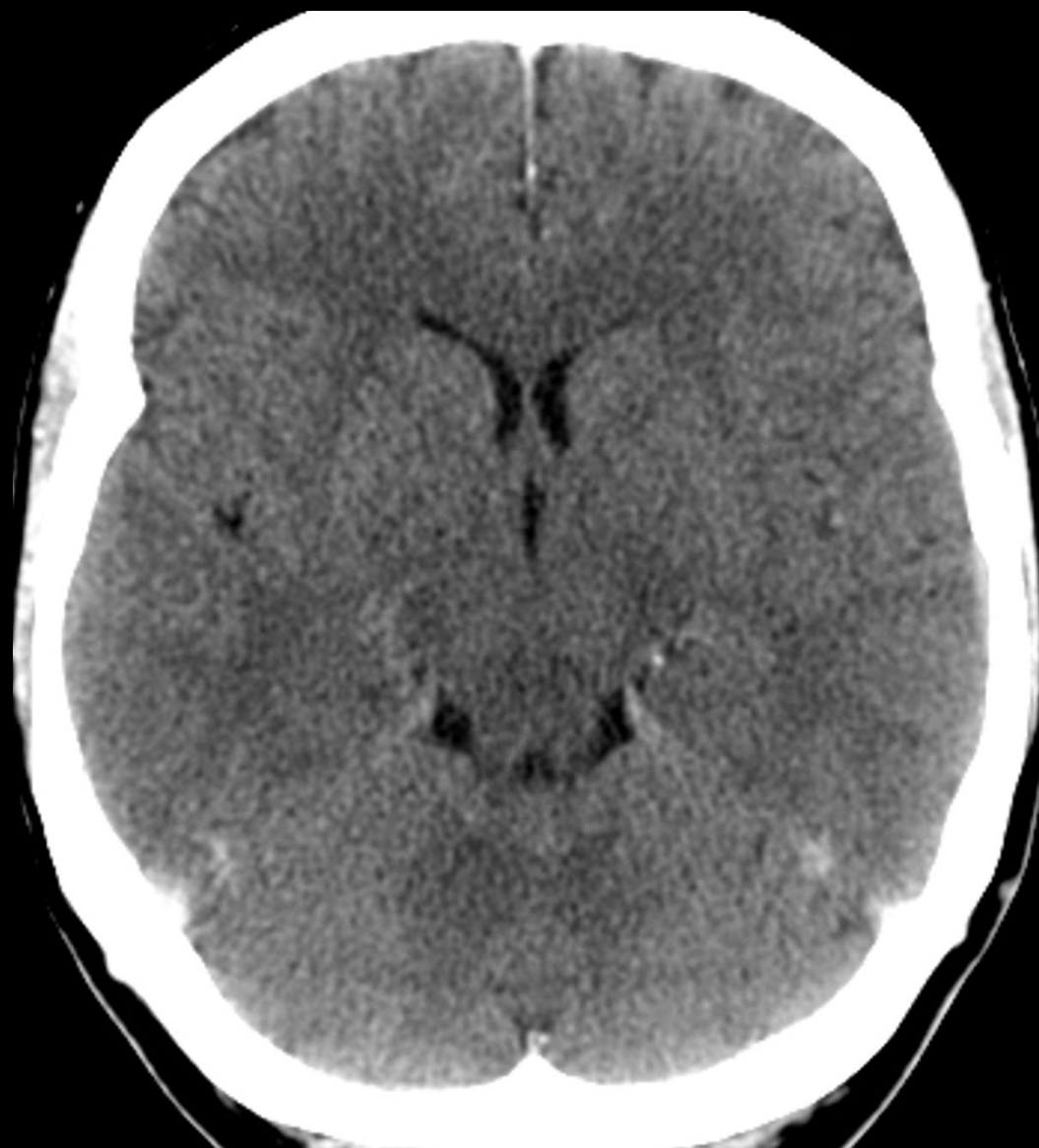
M66yr acute onset R leg weakness, CT normal

Stroke Imaging

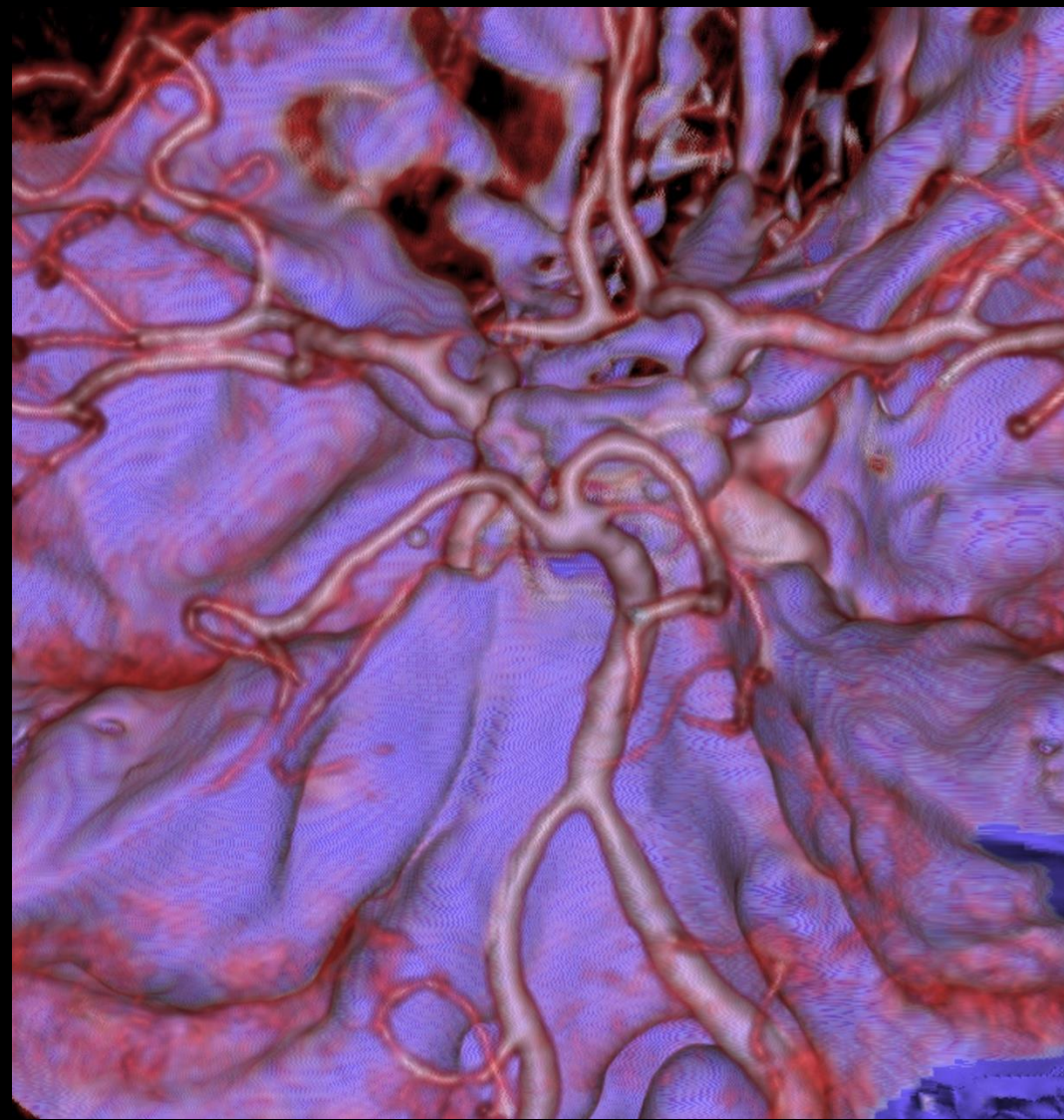
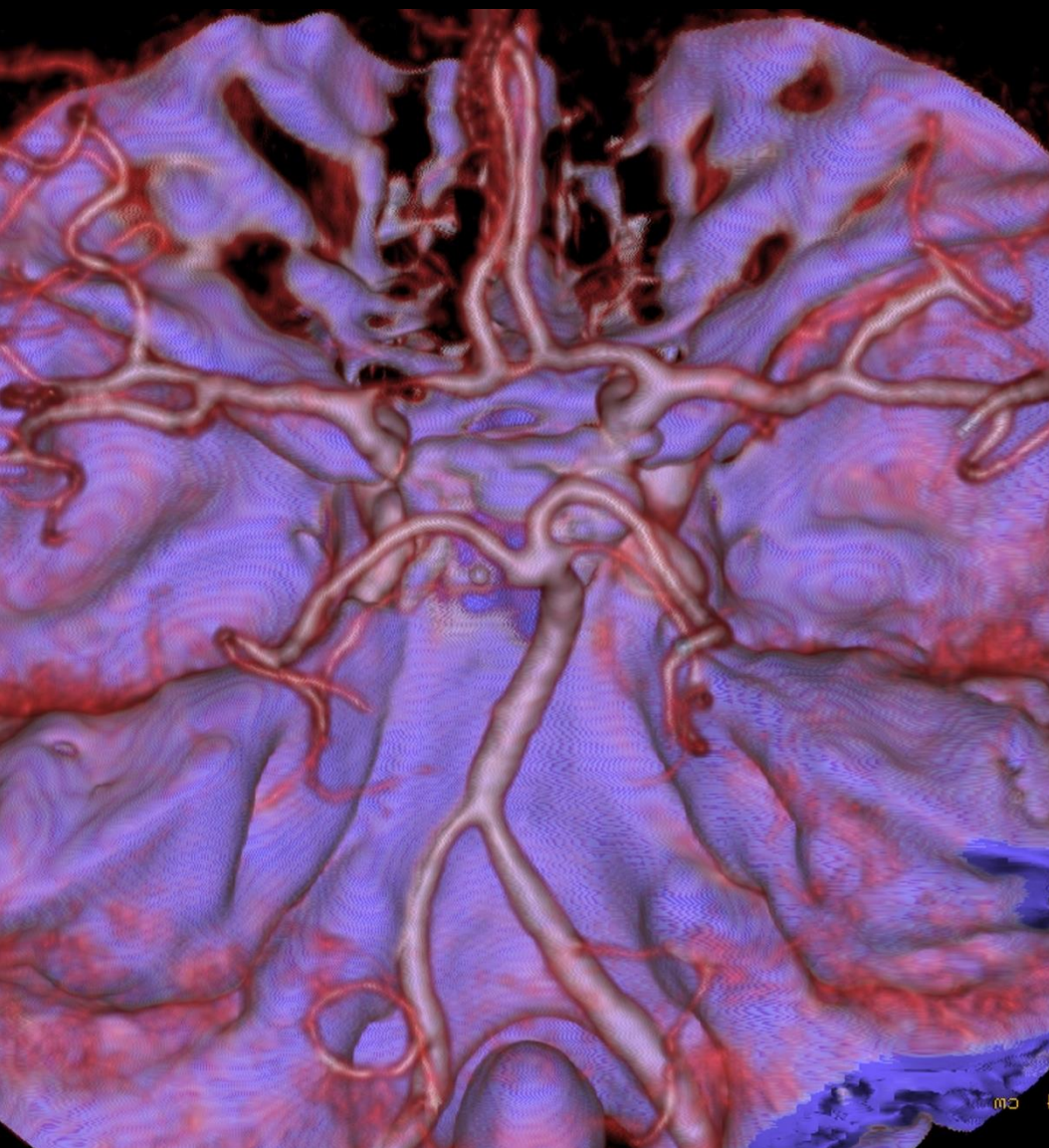
Craniocervical Vascular Imaging

- extracranial carotid stenosis
- carotid complicated plaque
- valvular lesions
- LV thrombus

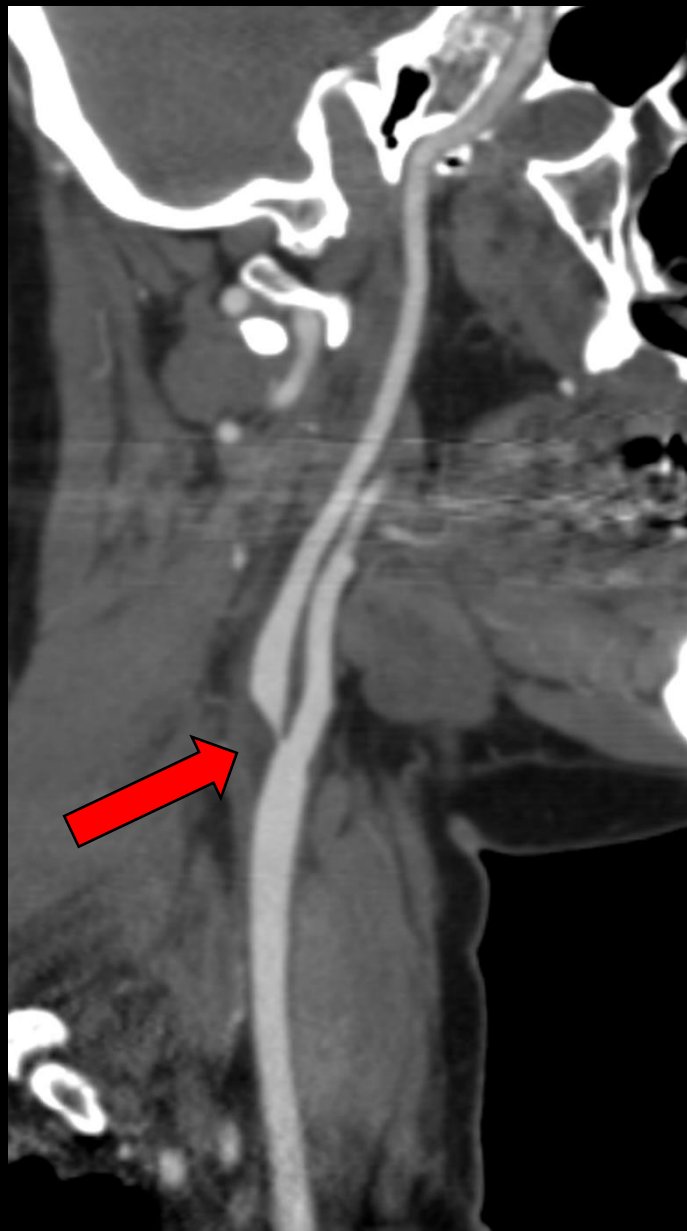
TIA



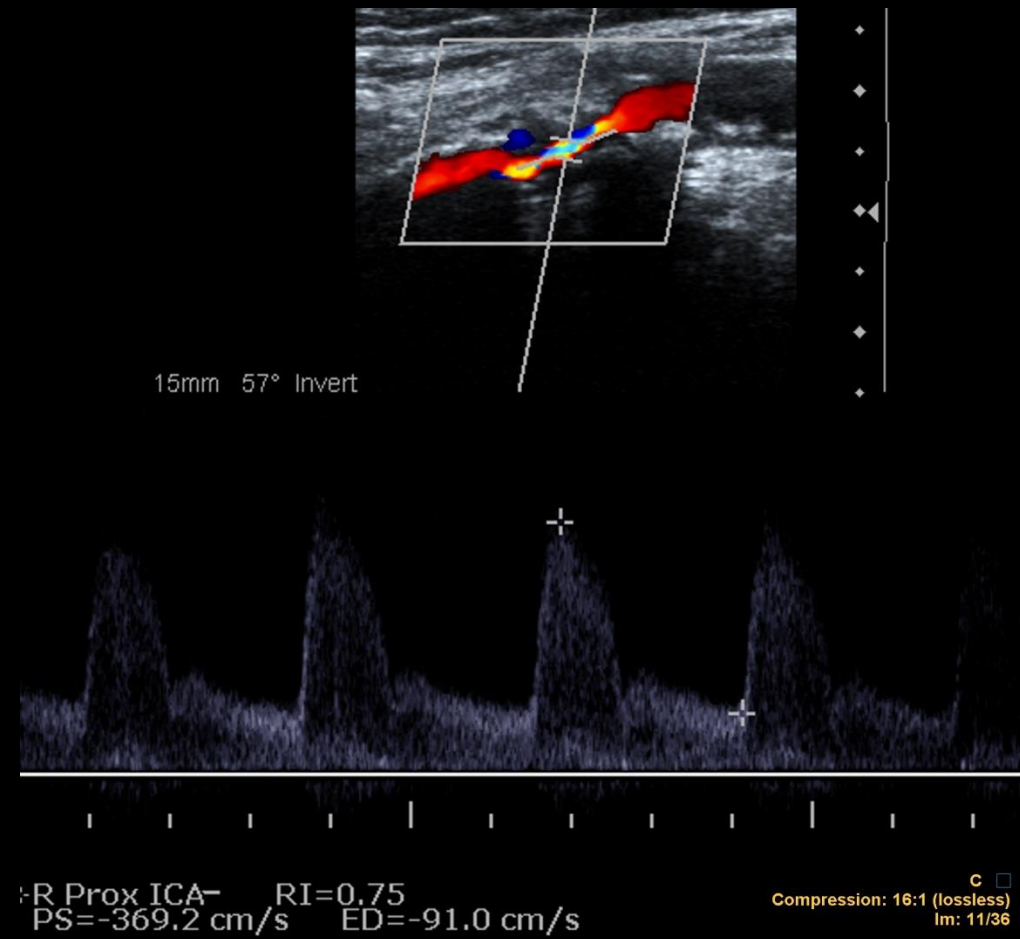
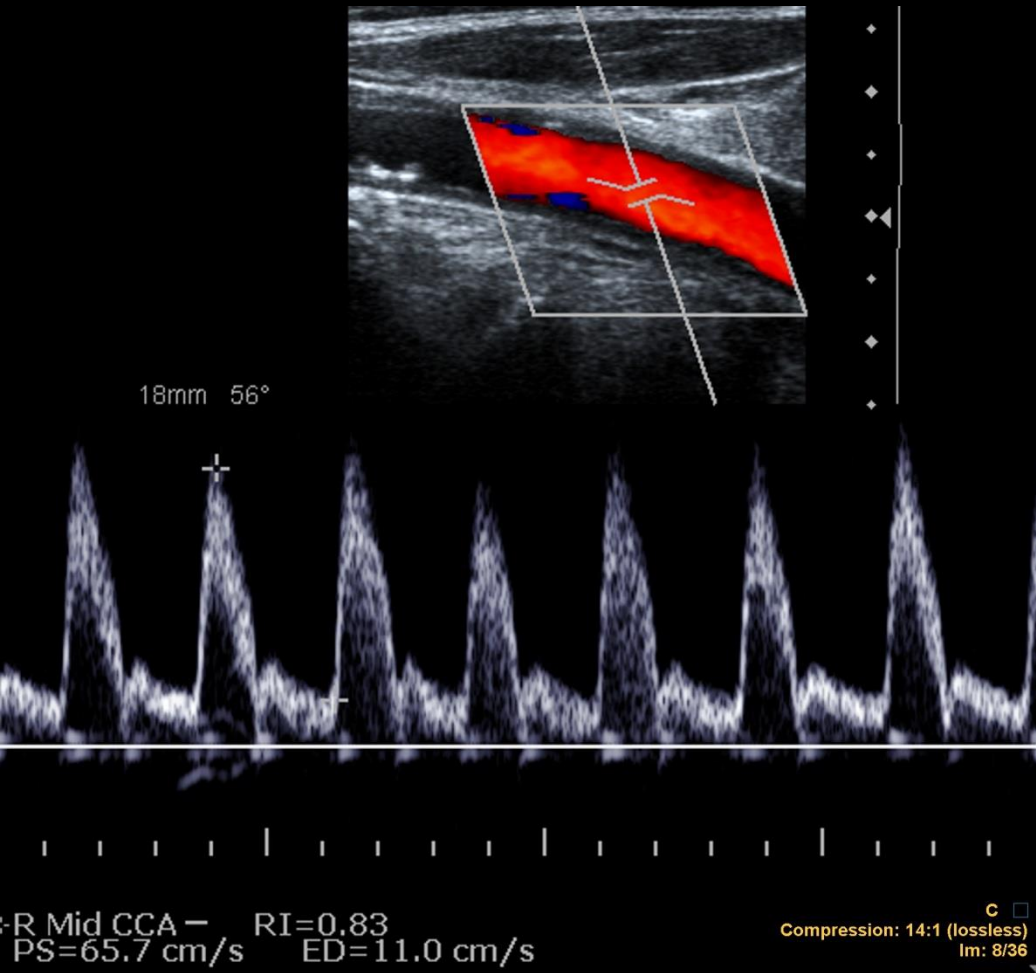
TIA



TIA

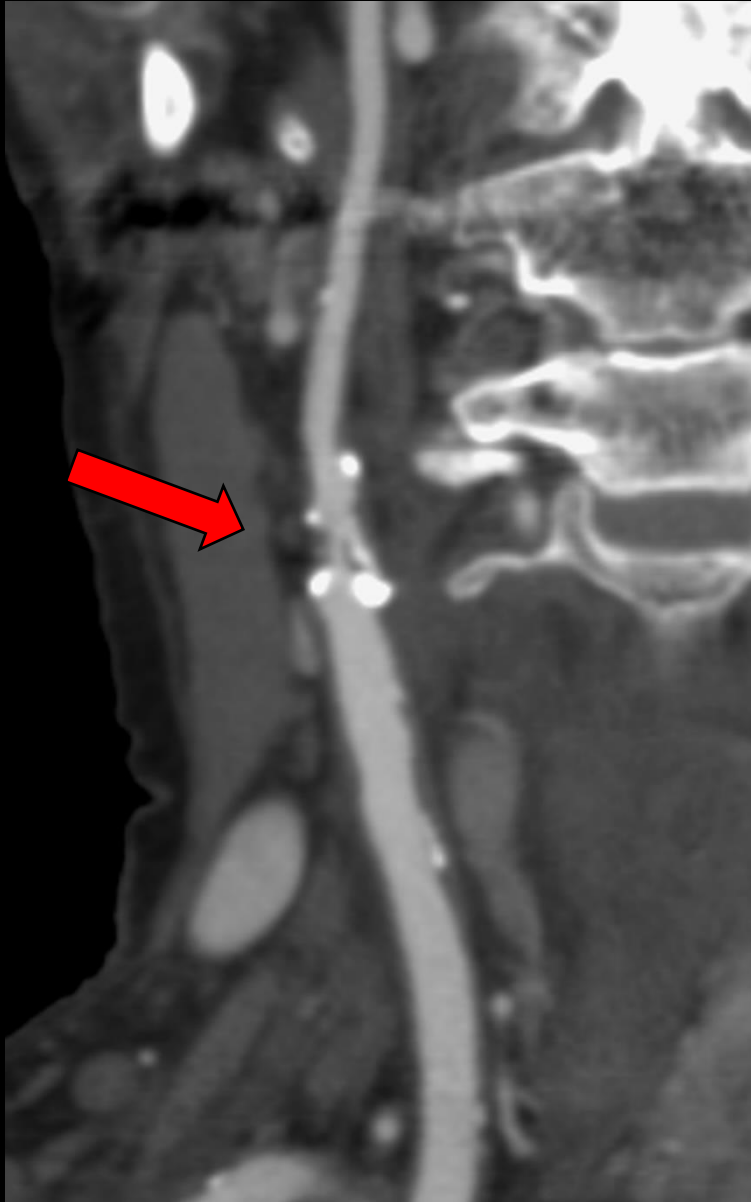


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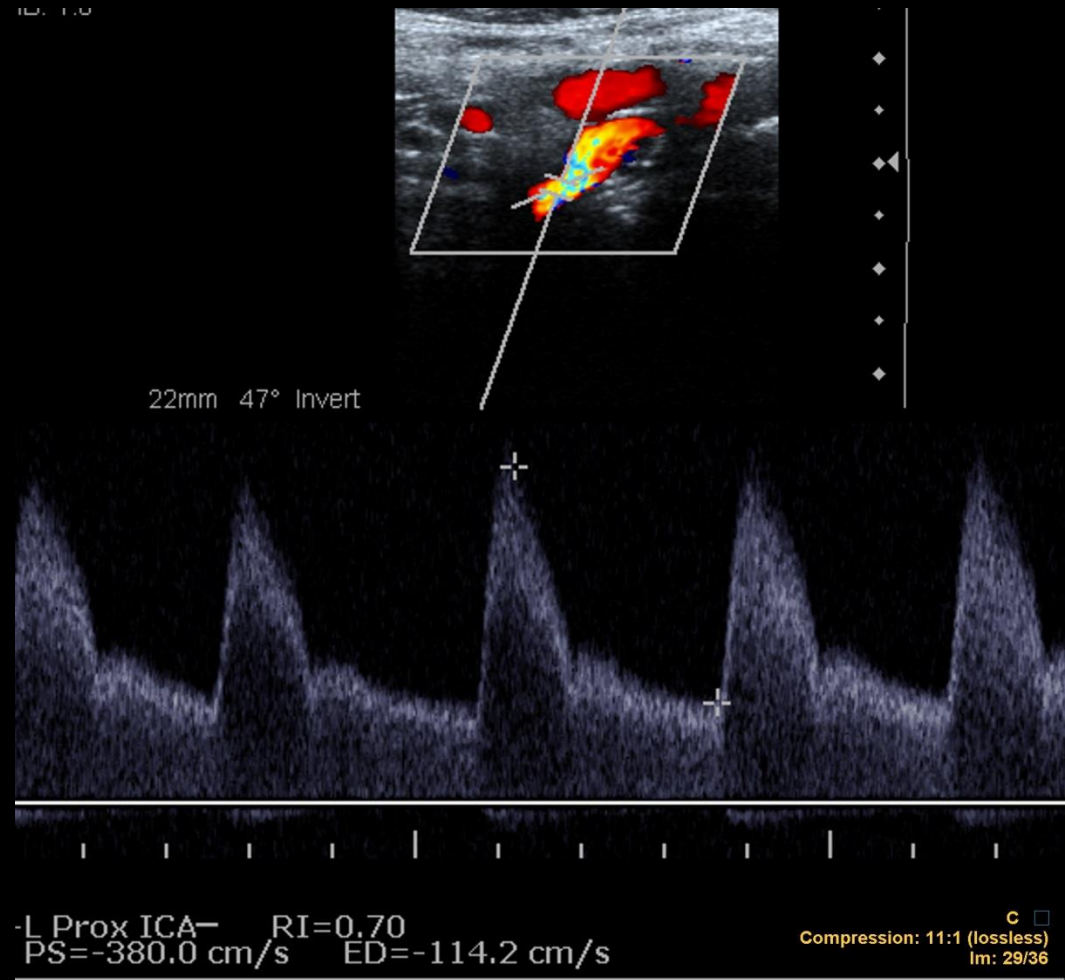
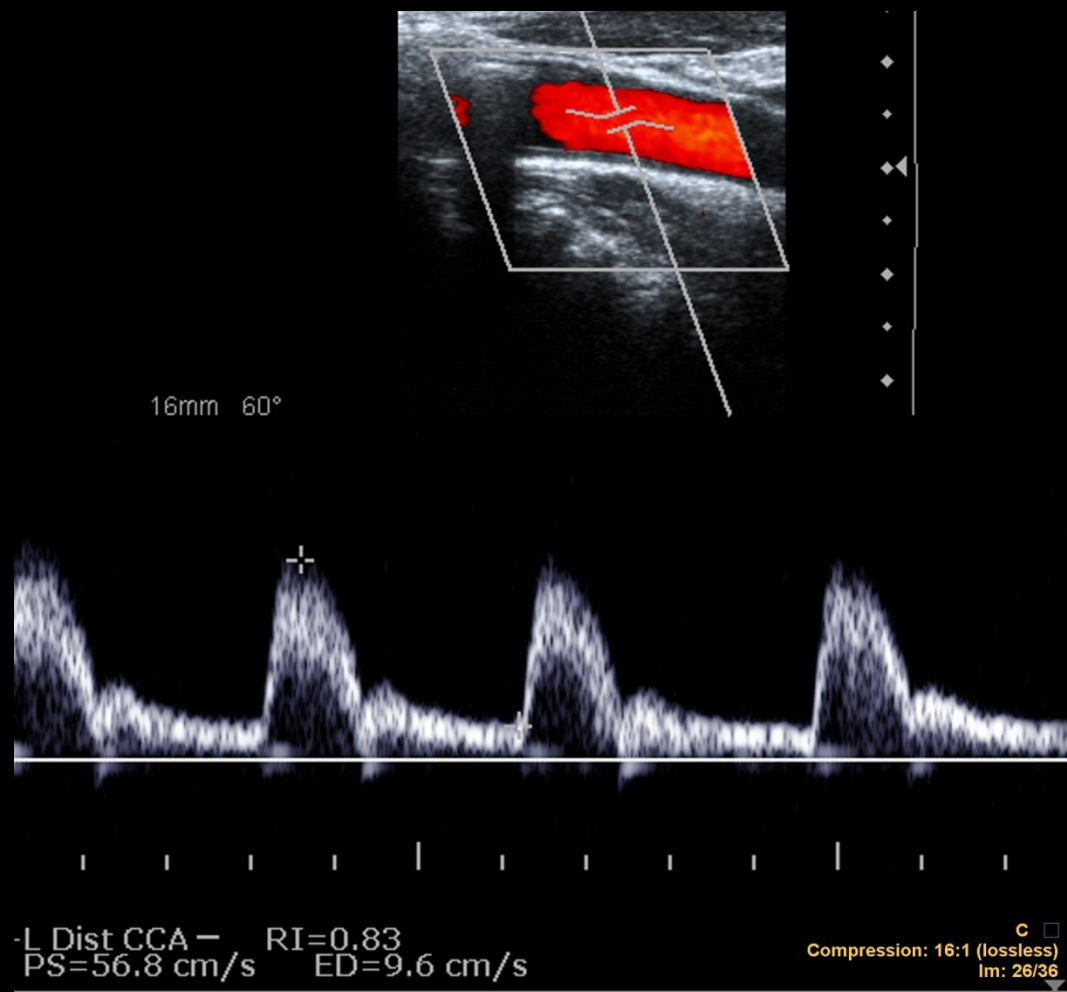
F83yr Carotid Doppler - RICA severe stenosis 80-95%

TIA



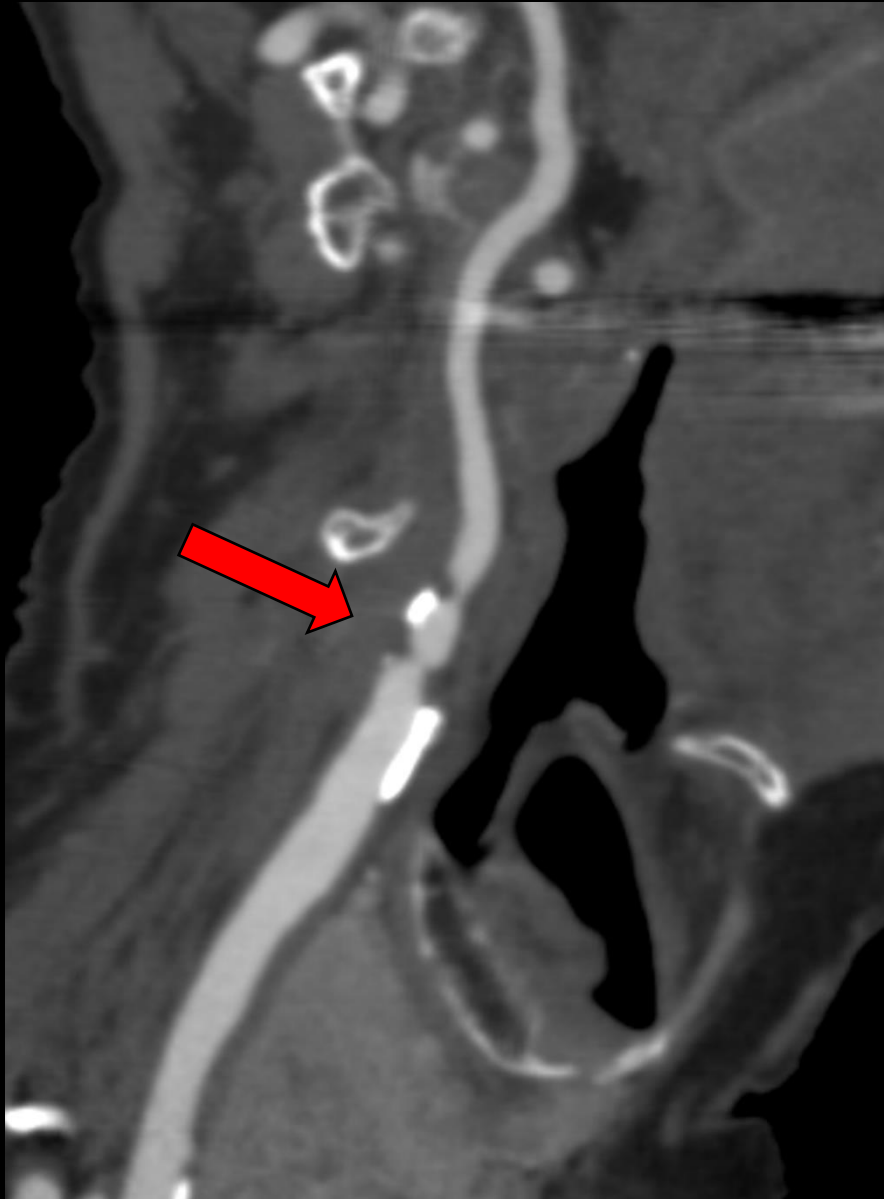
F83yr Extracranial CTA - RICA severe stenosis

TIA

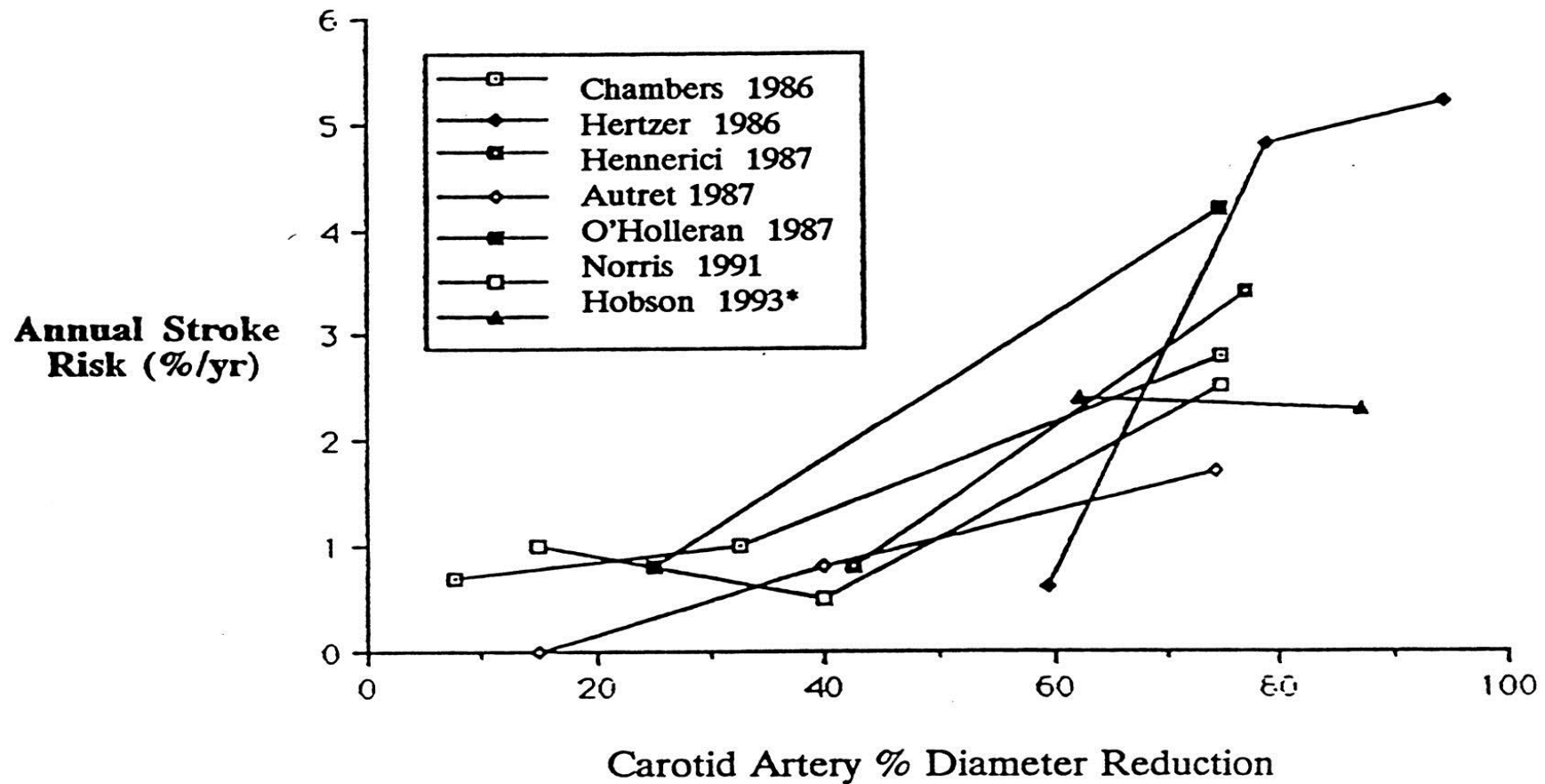


F83yr Carotid Doppler - LICA severe stenosis 80-95%

TIA



F83yr Extracranial CTA - LICA severe stenosis

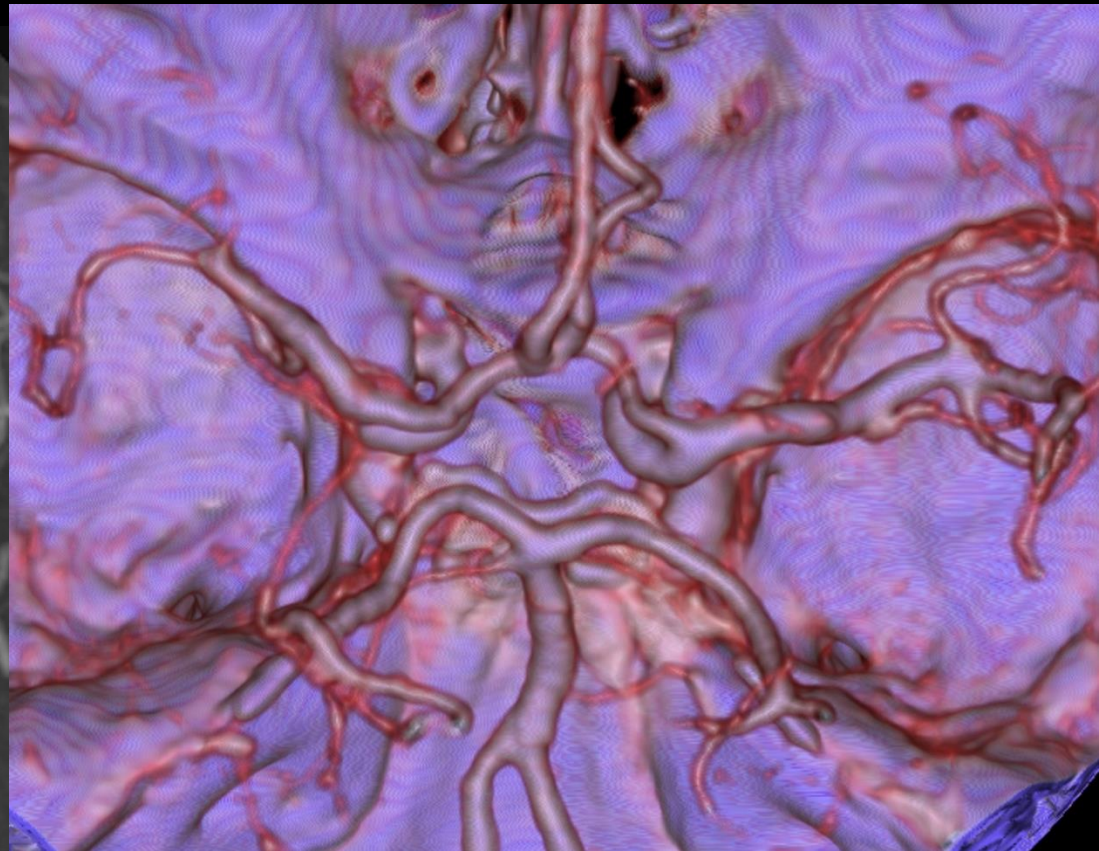
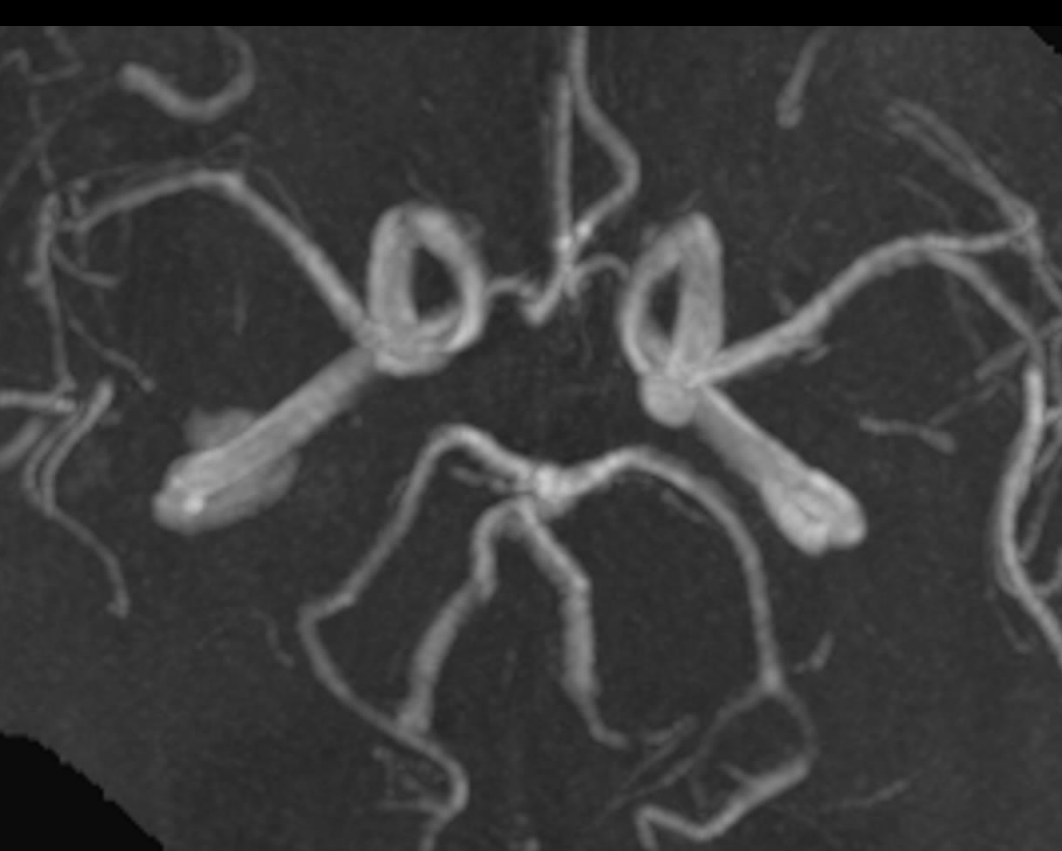


Stroke



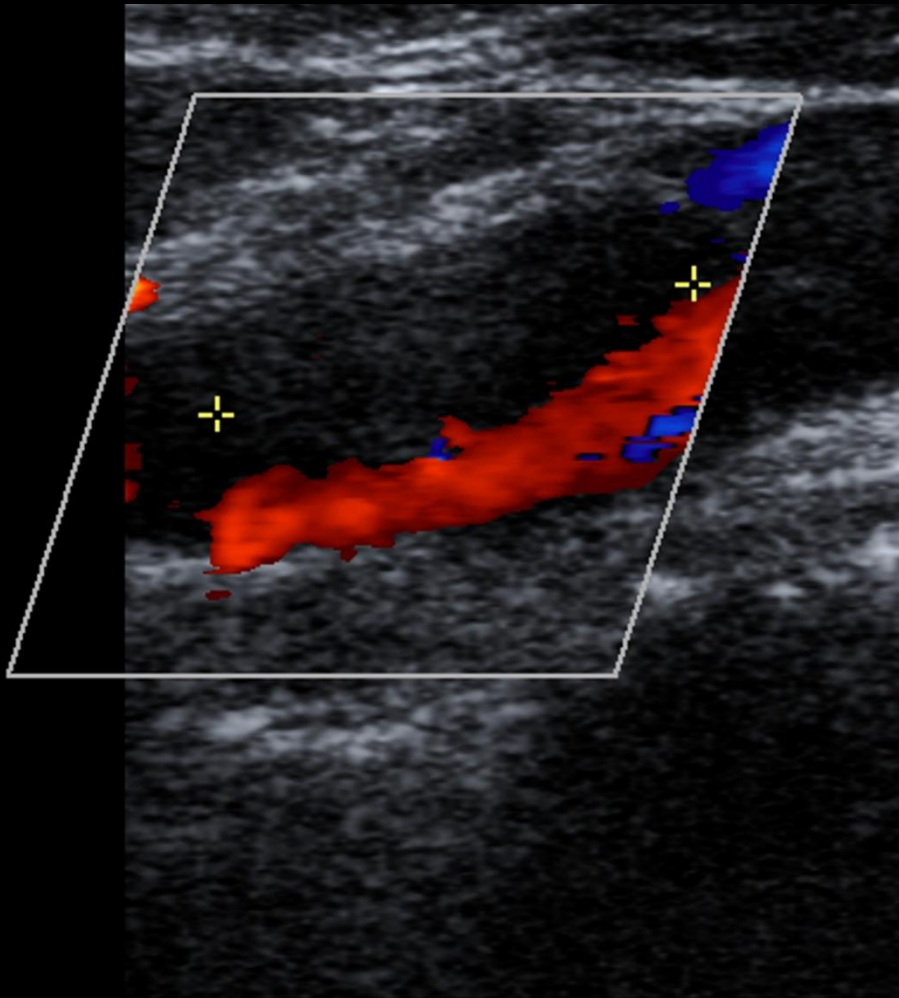
F83yr Extracranial CTA - RICA severe stenosis

Stroke

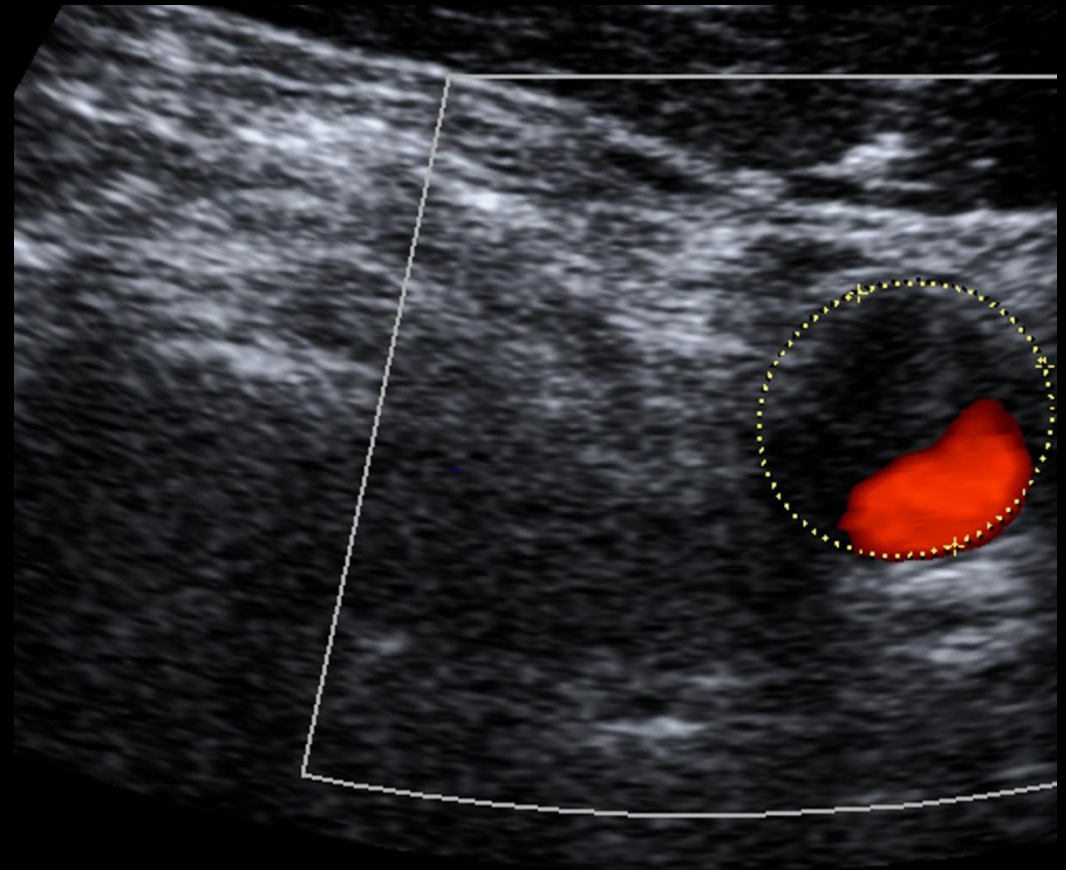


M56 Acute left hemiplegia and dysphasia

Stroke



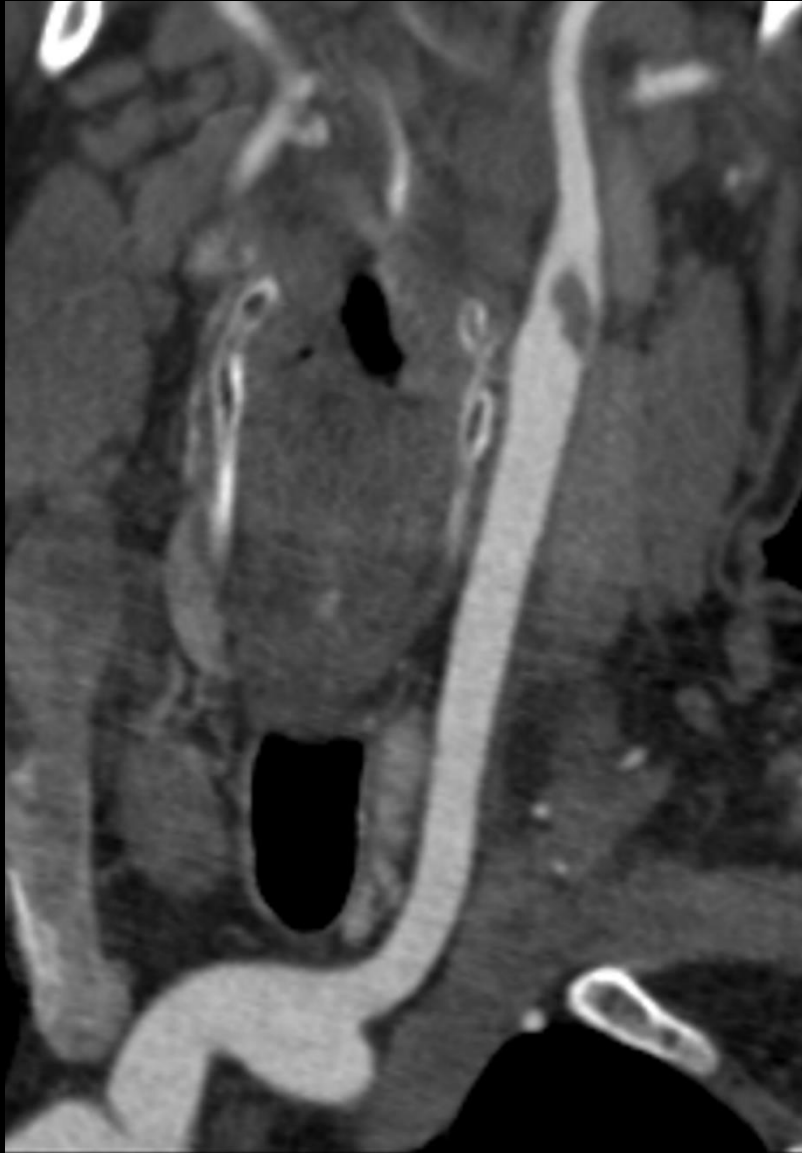
RT ICA PROX_



RT ICA PROX_

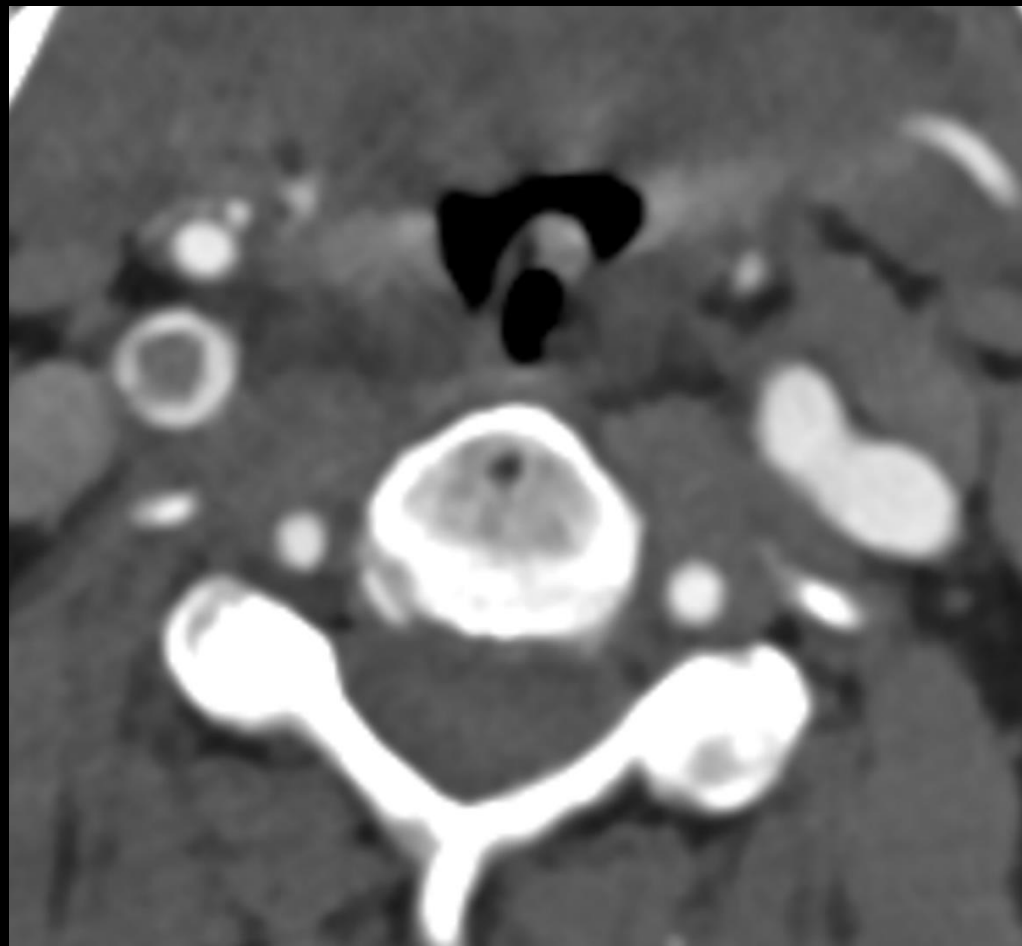
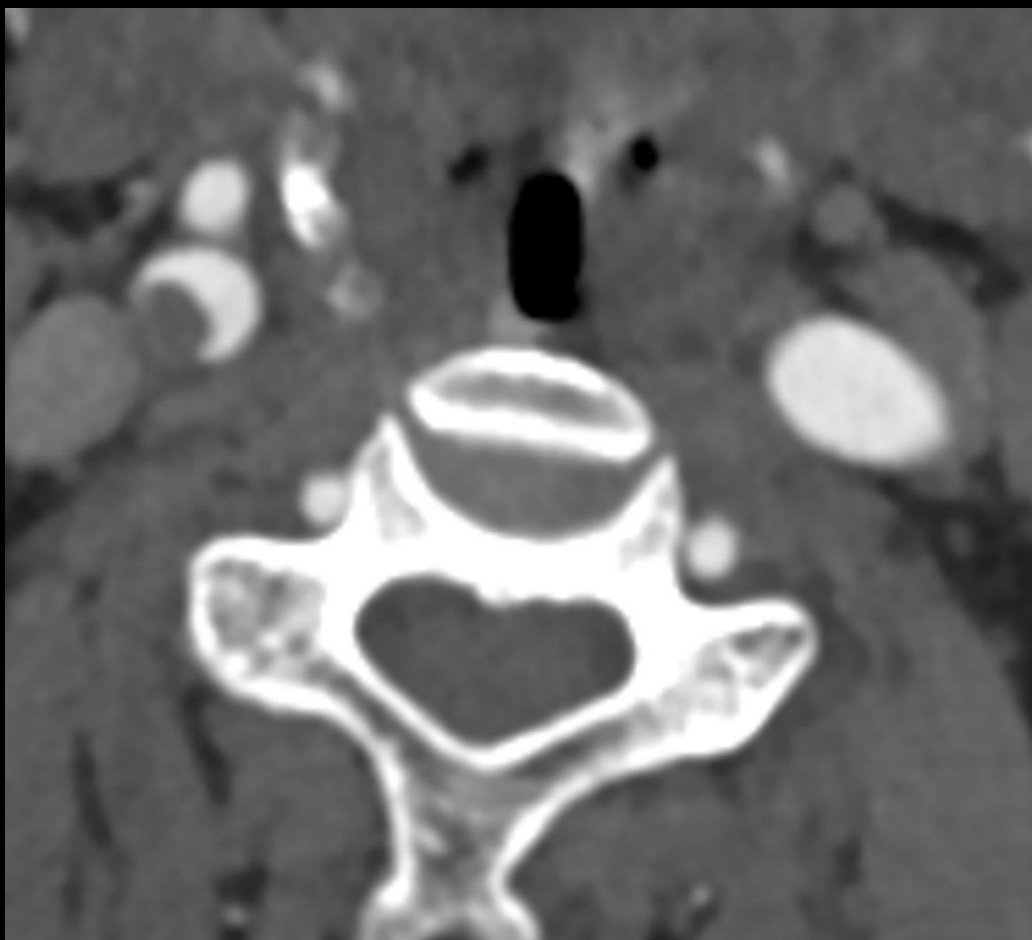
M56 Acute left hemiplegia and dysphasia

Stroke



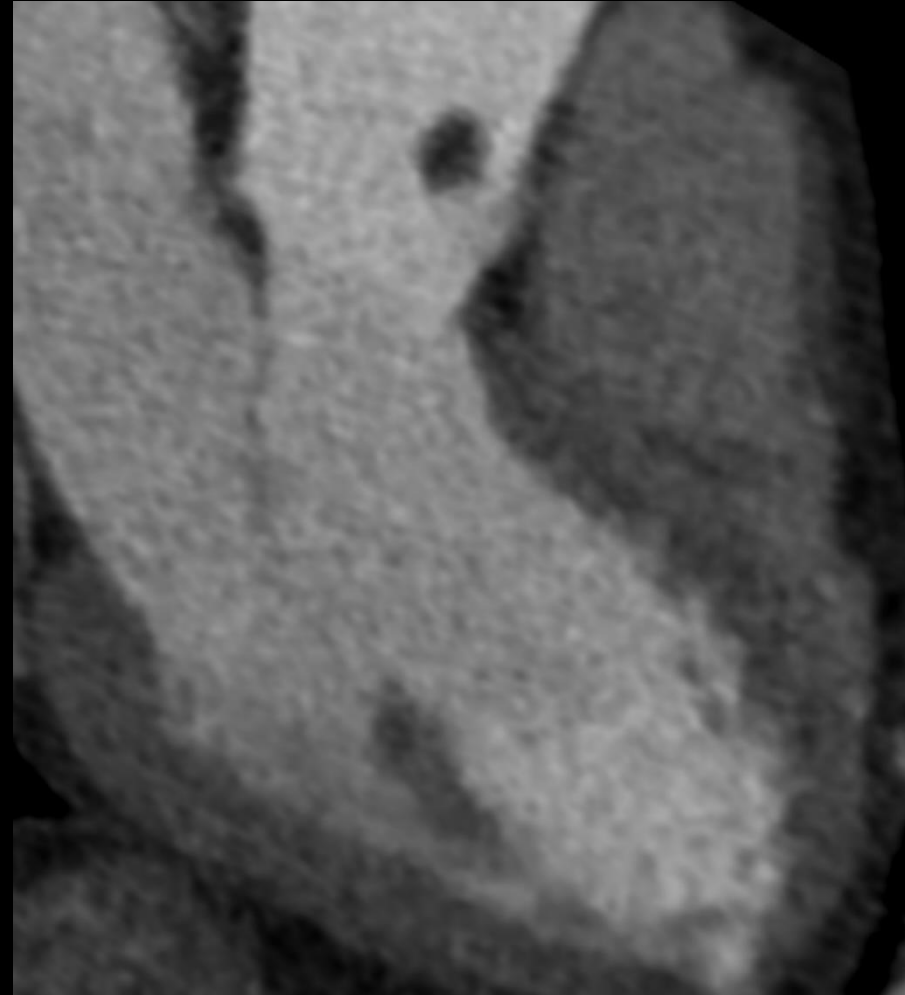
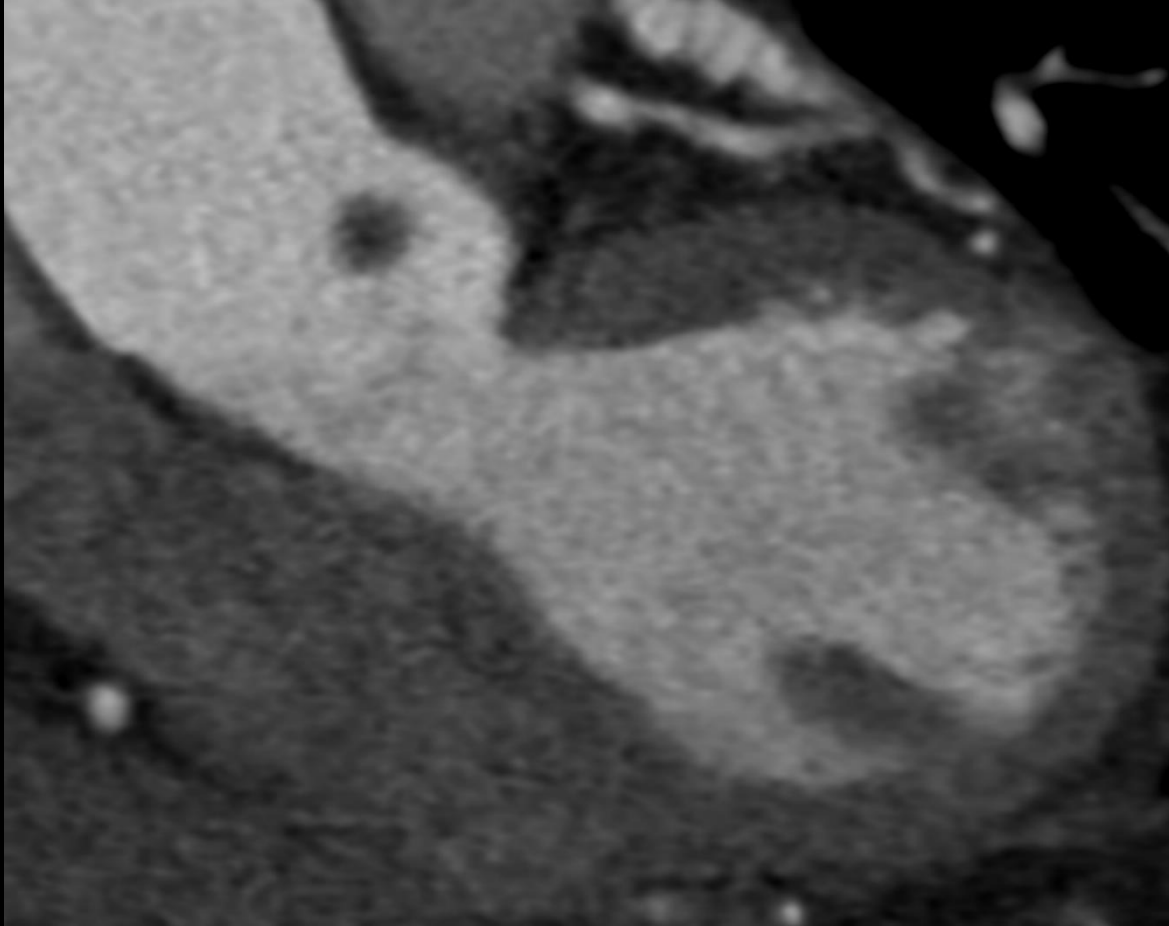
M56 Acute left hemiplegia and dysphasia, ICA free floating thrombus

Stroke



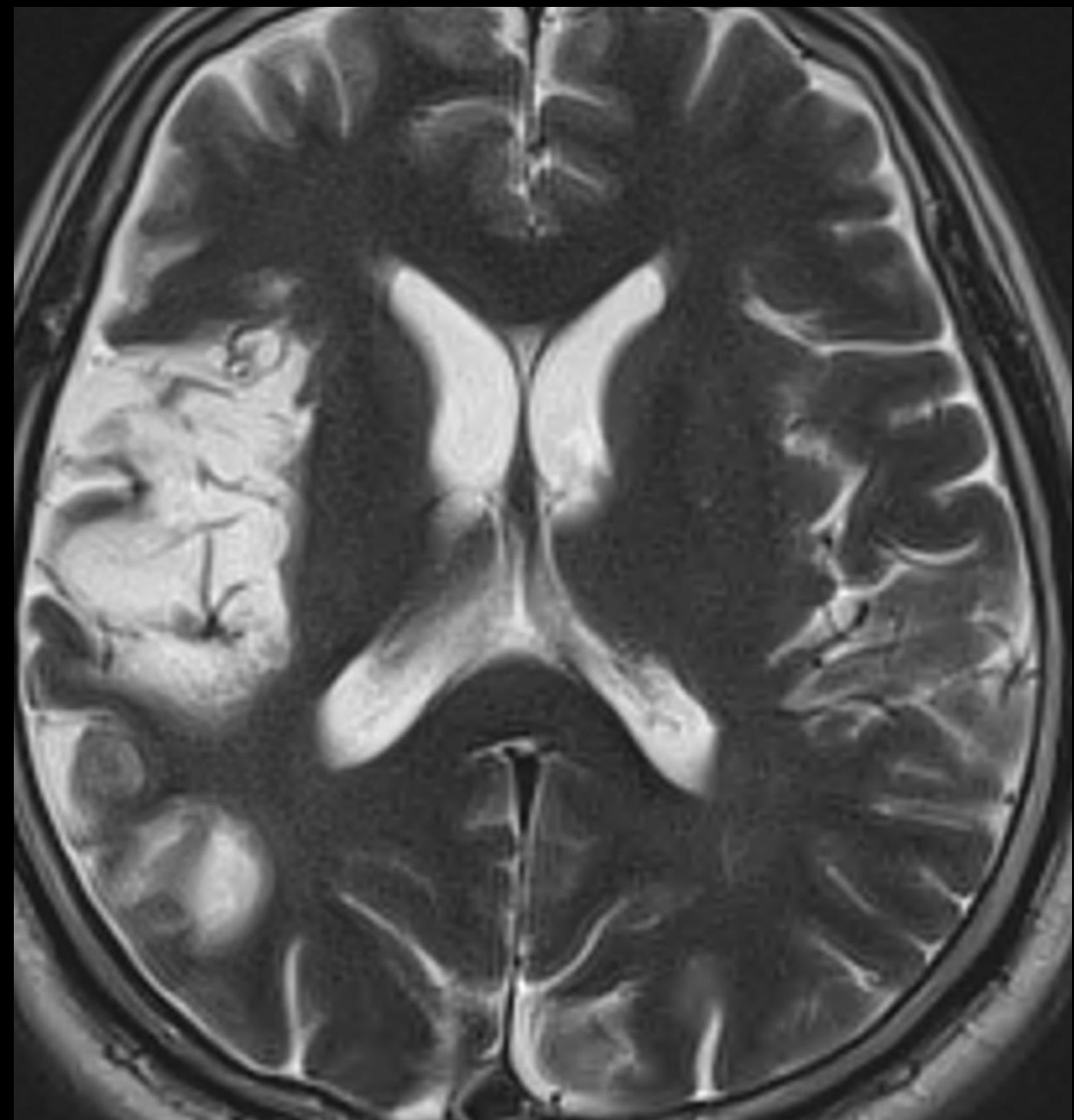
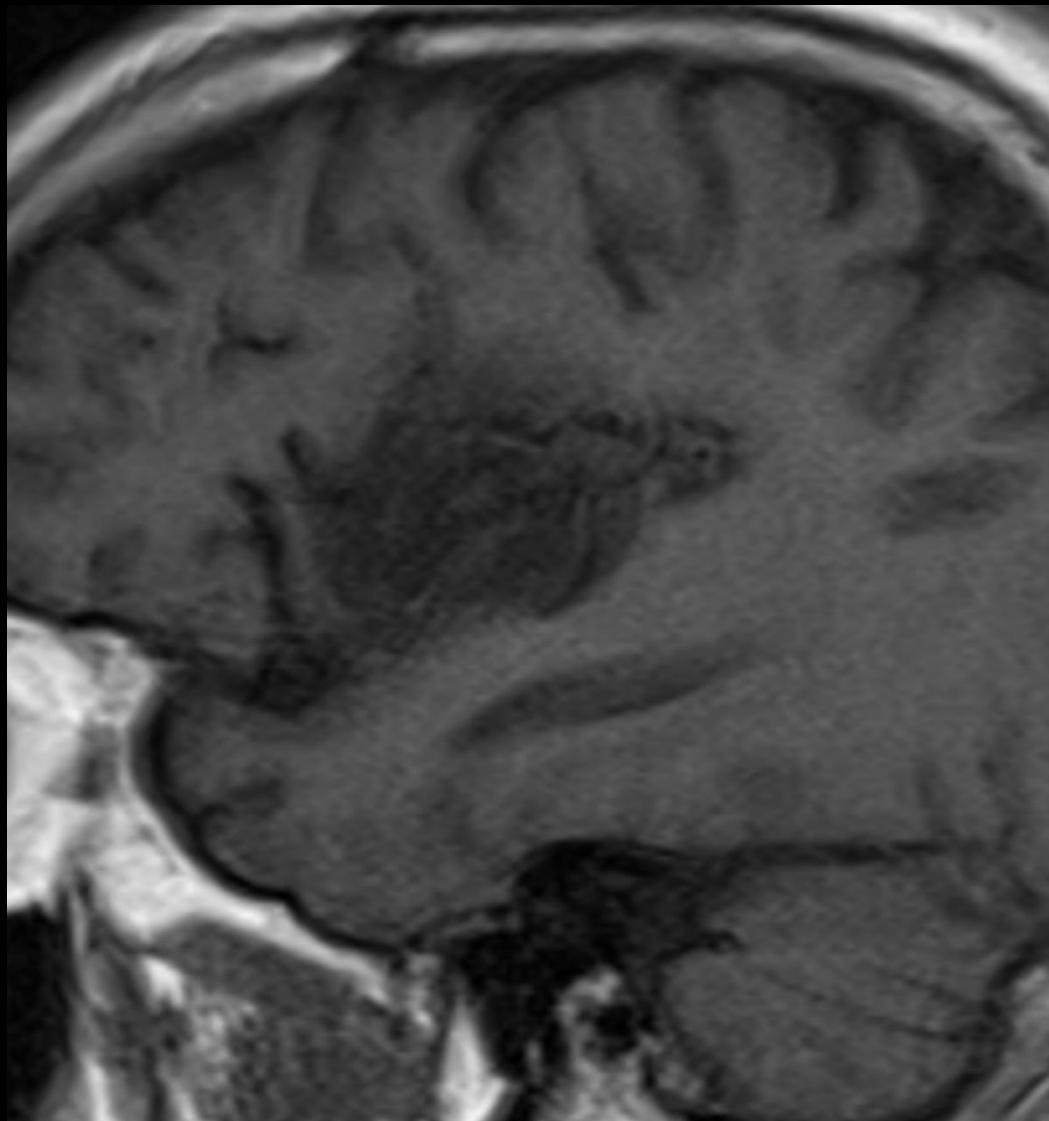
M56 Acute left hemiplegia and dysphasia, ICA free floating thrombus

Stroke



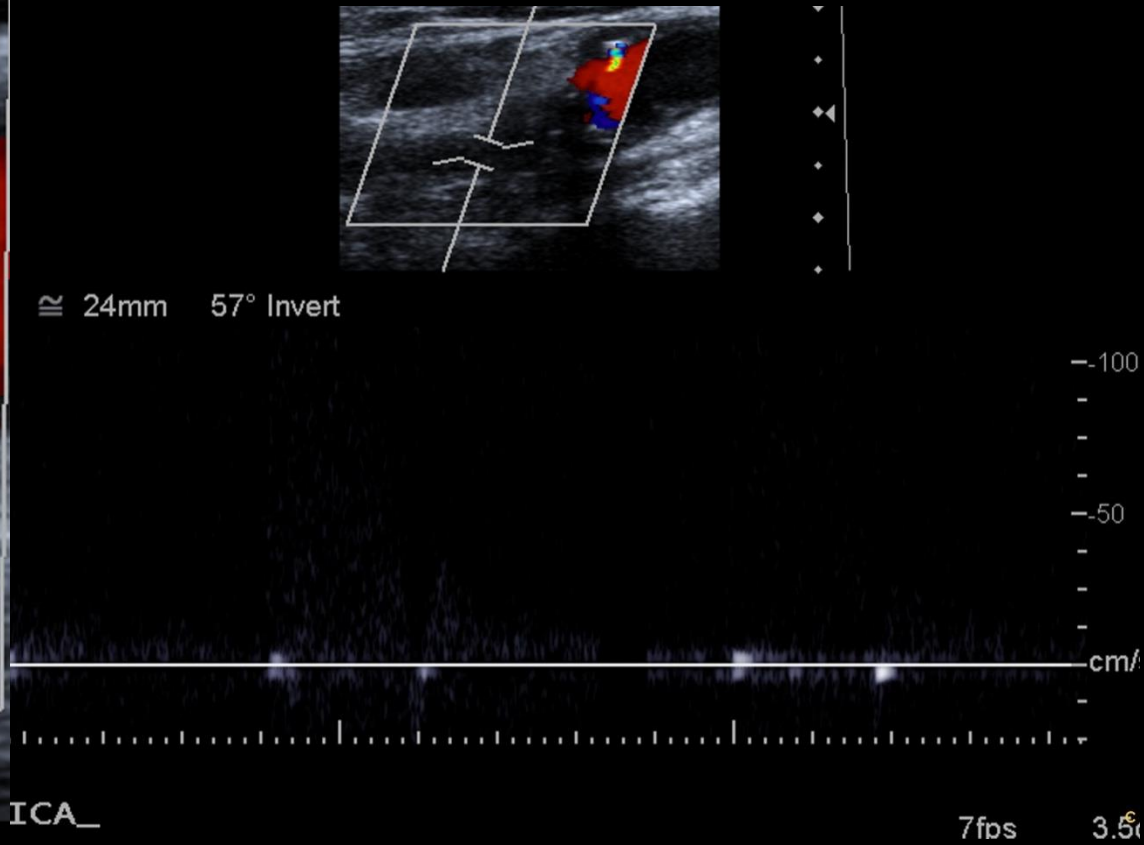
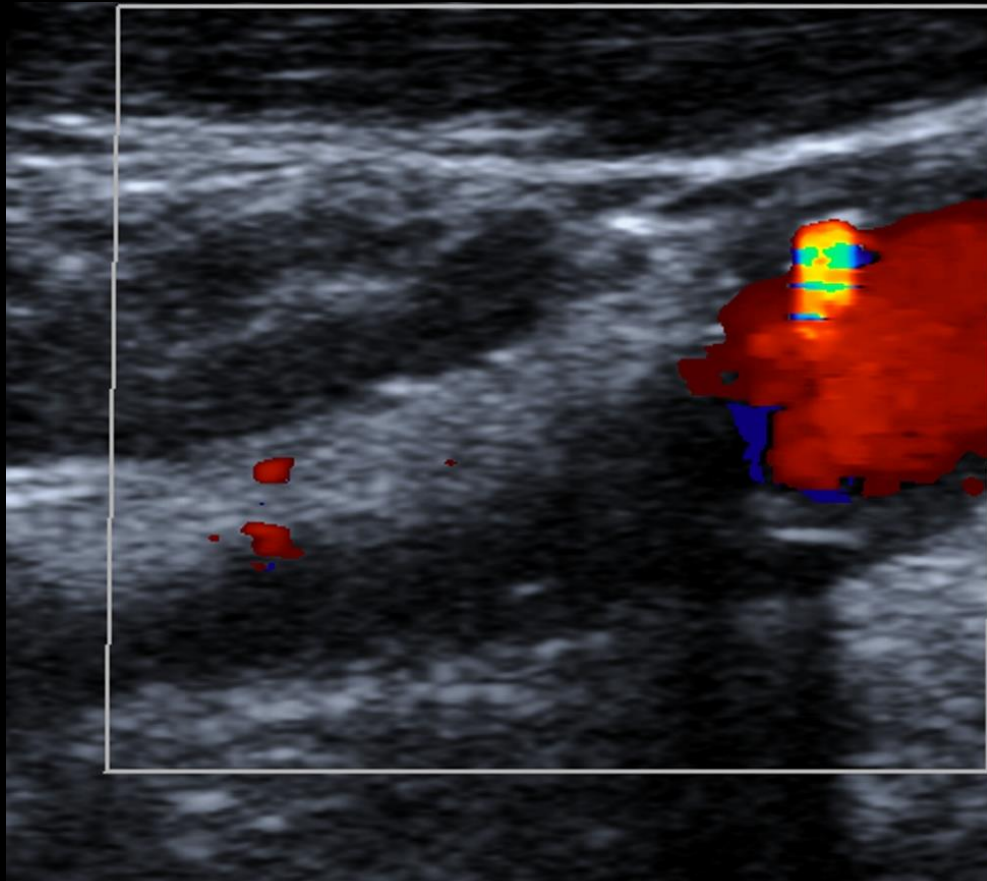
M56 Acute left hemiplegia and dysphasia, AoV mass

Stroke



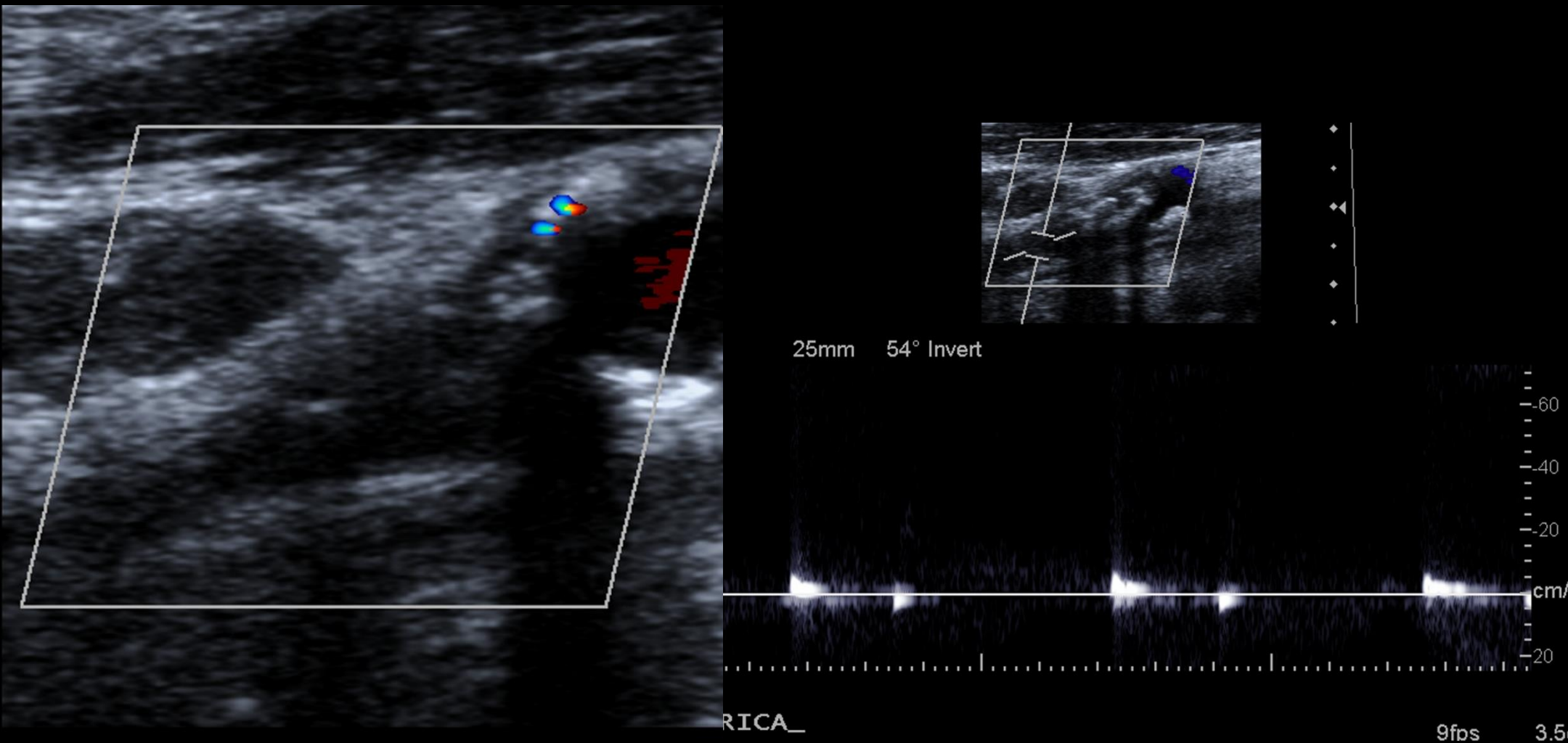
M56 chronic MCA occlusive infarct, ICA thrombus, AoV mass

Stroke



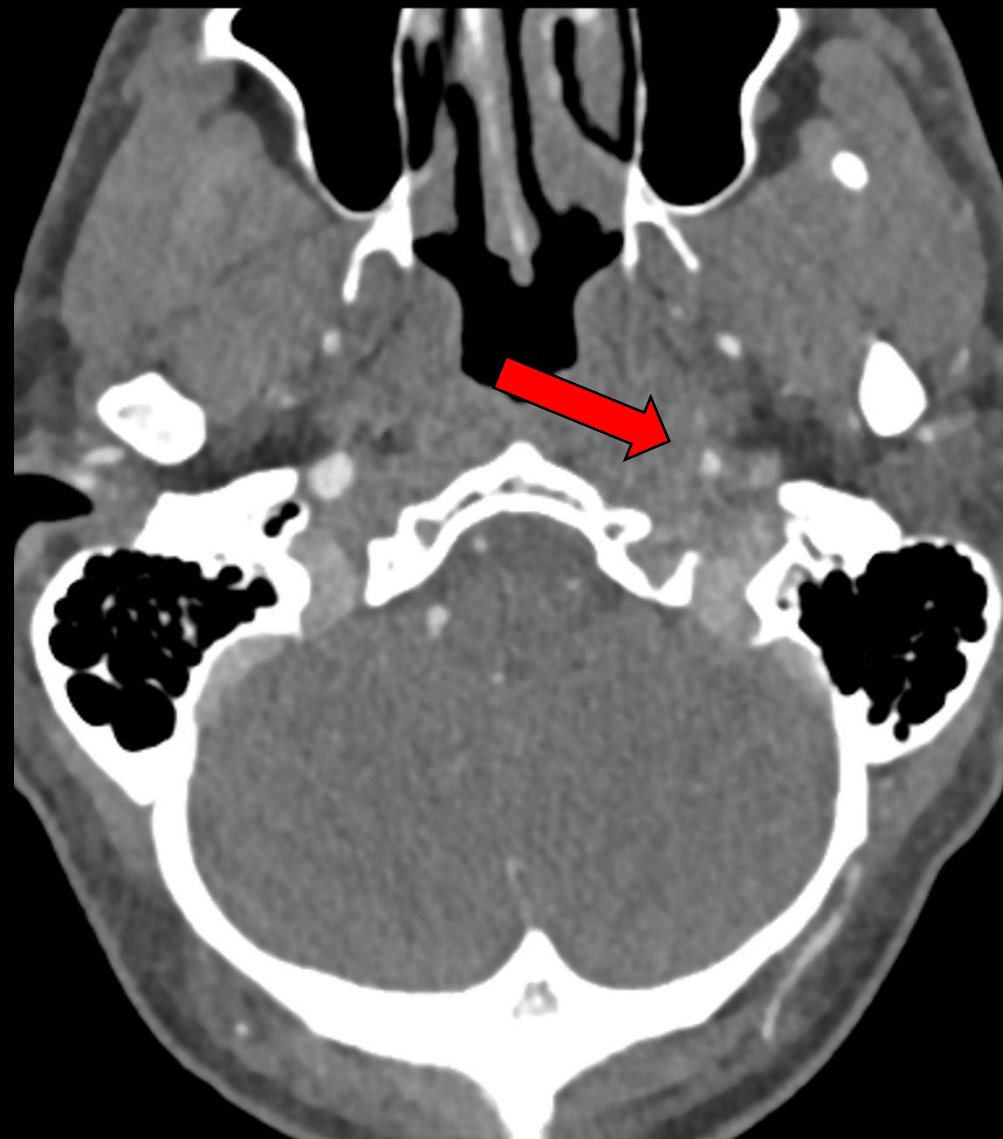
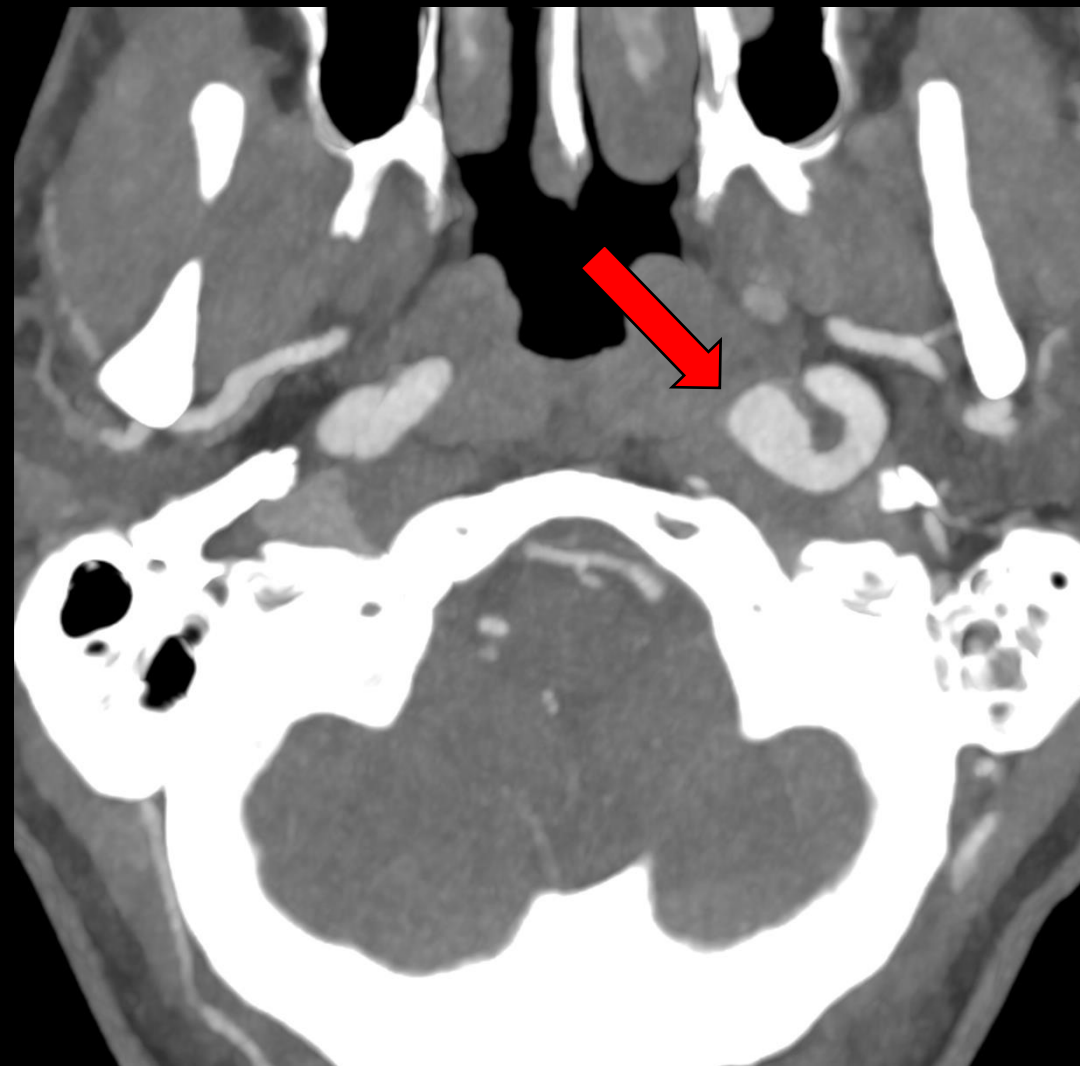
M74 Doppler LICA occlusion

Stroke



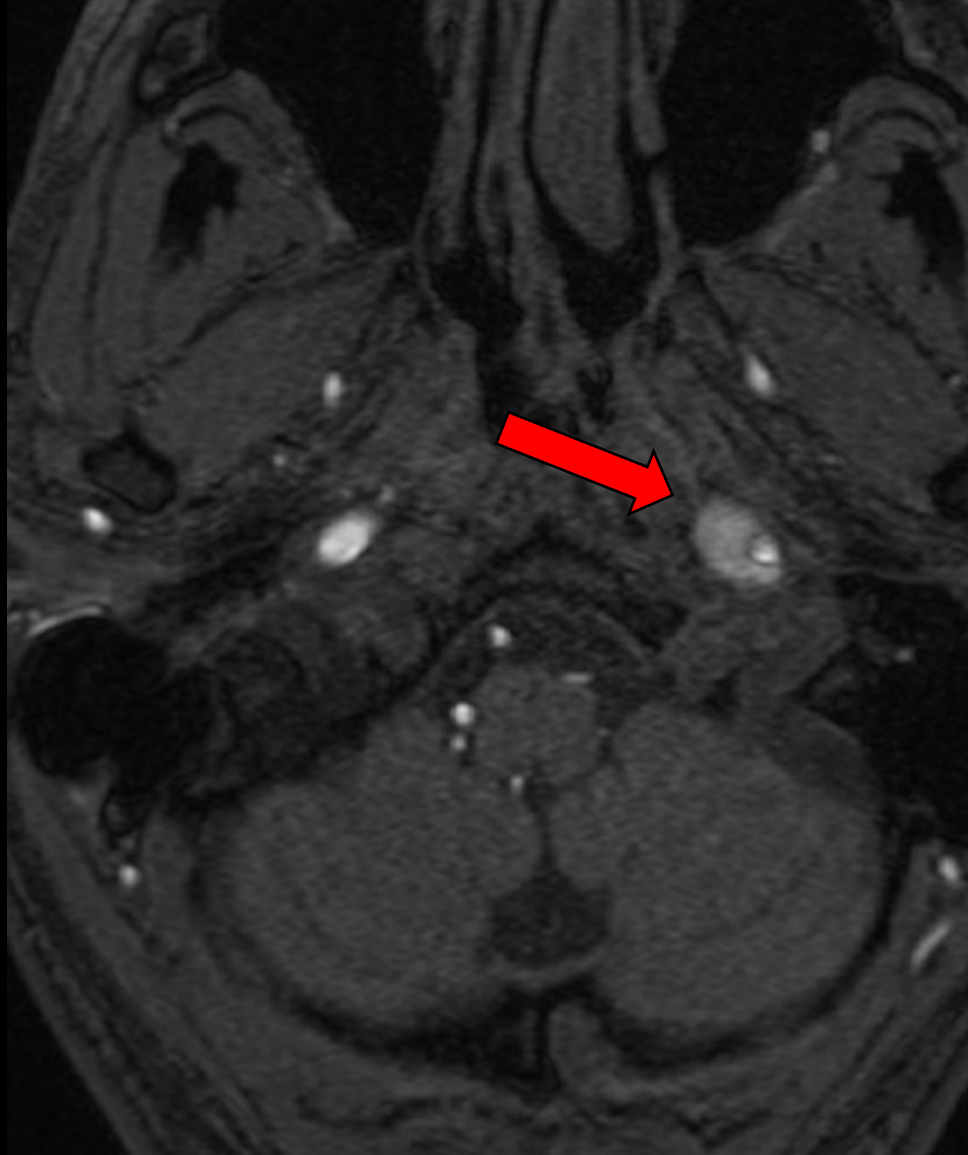
M74 Doppler RICA occlusion

Stroke

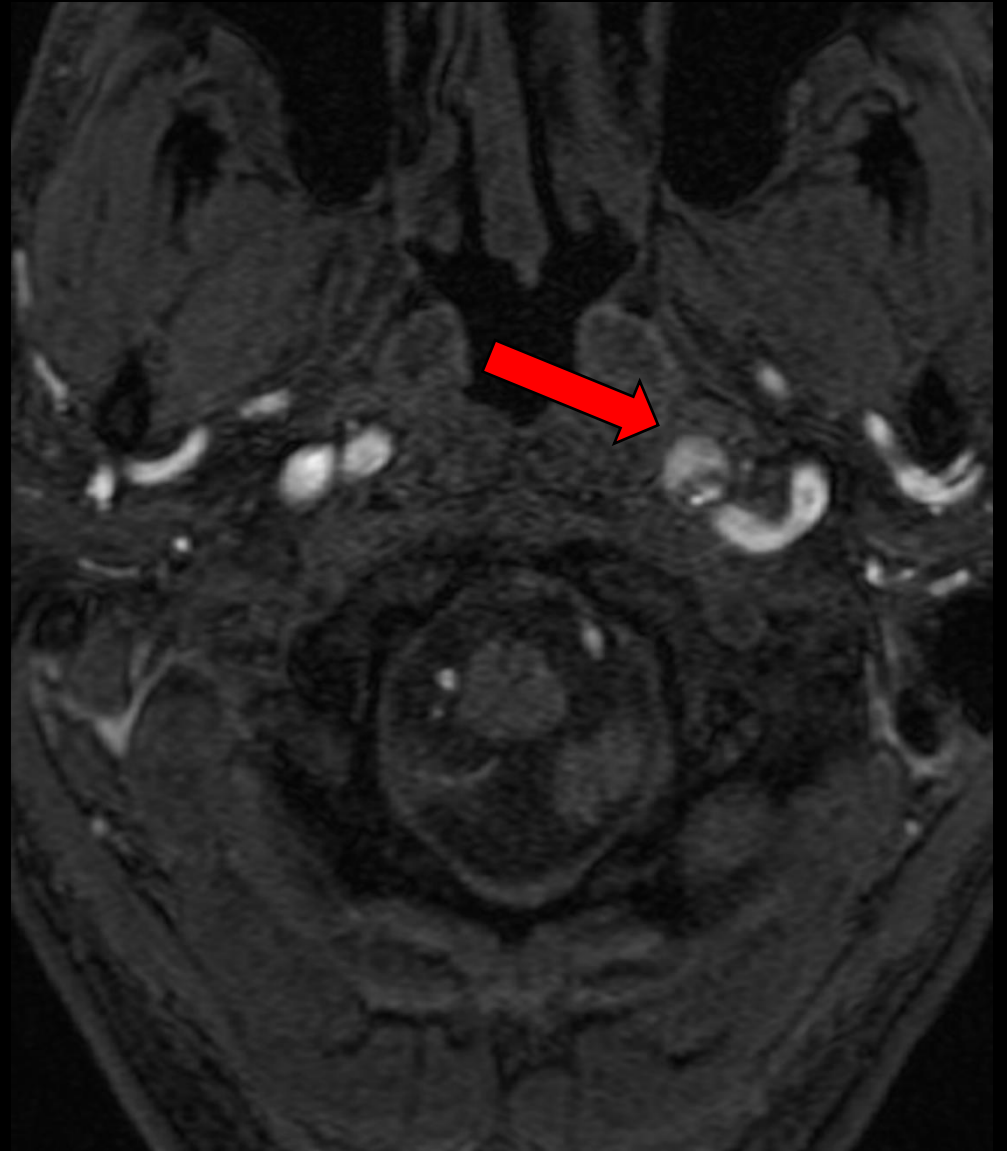


M54yr neck discomfit, R sided weakness

Stroke



MRA



MRA

Stroke



RICA

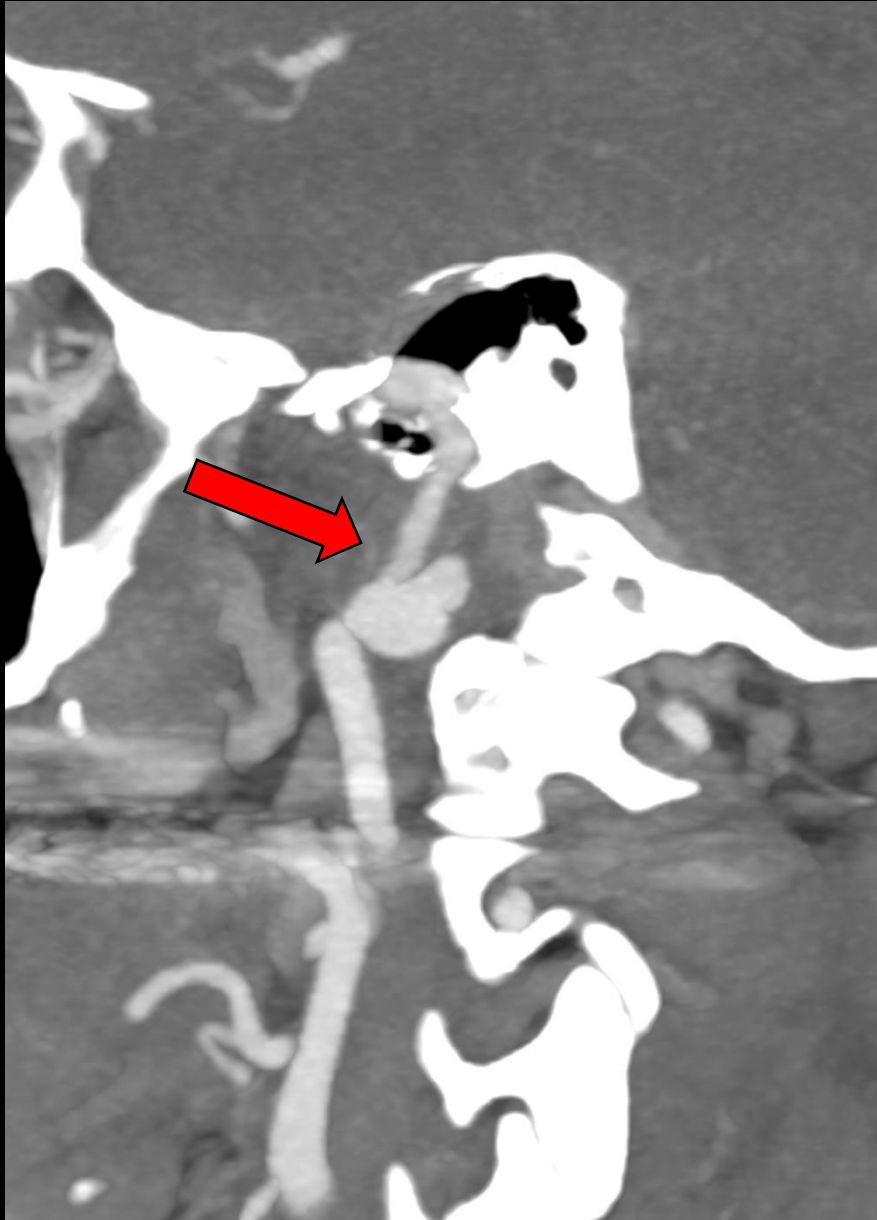


LICA



COW

Stroke



CTA LICA



MR T2

Stroke

Guidelines 2

AHA/ASA Guidelines in Acute Ischemic Stroke

Stroke 2013

Stroke

Recommendations for Acute Non resolved Cerebral Ischemic Syndromes (infarction)

1. Emergency **brain imaging** is recommended **before** initiating any specific therapy to treat acute ischemic stroke (*Class I; Level of Evidence A*). NECT is sufficient for emergency management.
2. Either **NECT-MRI** is recommended **before** iv rtPA administration to exclude ICH (absolute contraindication) and to determine whether CT hypodensity or MRI hyperintensity of ischemia is present - (*Class I; Level of Evidence A*).
3. Intravenous **fibrinolytic therapy** is recommended in the setting of early ischemic changes (other than frank hypodensity) on CT, regardless of their extent - (*Class I; Level of Evidence A*).
4. A **noninvasive intracranial vascular study** is strongly recommended during the initial imaging evaluation of the acute stroke patient if either **intra-arterial fibrinolysis or mechanical thrombectomy** is contemplated for management but should not delay intravenous rtPA if indicated (*Class I; Level of Evidence A*).
5. In intravenous fibrinolysis candidates, brain imaging study should be interpreted **within 45 minutes** of patient arrival in ED by a physician with expertise in reading CT and MRI studies of the brain parenchyma (*Class I; Level of Evidence C*).
6. **CT-MRI perfusion and DWI imaging**, including measures of infarct core-penumbra, may be considered for the selection of patients for acute reperfusion therapy **beyond** the time windows (**CHC Hospital > 4.5hrs**) for intravenous fibrinolysis. These techniques provide additional information that may improve diagnosis, mechanism, and severity of ischemic stroke and allow more informed clinical decision making (*Class IIb; Level of Evidence B*).
7. **Frank hypodensity on NECT** may increase the risk of hemorrhage with fibrinolysis and should be considered in treatment decisions. If frank hypodensity involves more than 1/3 MCA territory, iv rtPA treatment should be **withheld** (*Class III; Level of Evidence A*).

TIA

Summary Recommendations for Resolved Cerebral Ischemic Syndromes (TIA)

1. (TIA): a transient episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction.
2. Patients with TIAs are at **high risk** of early stroke, and their risk may be stratified by clinical scale, vessel imaging, and diffusion magnetic resonance imaging.
3. Diagnostic recommendations for TIA patients:
 - undergo **neuroimaging < 24 hours** post symptom onset, preferably **MRI**
 - imaging **extracranial cervical vessels** should be performed (**Doppler CT-MRA**)
 - noninvasive **imaging of intracranial vessels** is reasonable (**CTA/MRA**)
4. **ECG** should occur as soon as possible after TIA
 - prolonged cardiac monitoring (Holter) and echocardiography are reasonable in patients in whom a vascular etiology is not identified
5. **Routine blood** tests are reasonable
6. Reasonable to hospitalize patients with TIA if presenting within 72 hours and have an ABCD² score ≥ 3 , indicating high risk of early recurrence, or the evaluation cannot be rapidly completed on an outpatient basis.

Stroke

Thrombolysis Evidence Base - pre IST3 study 2013

Acute ischemic stroke thrombolysis selection

“Ideal candidates”

- **early** < 90min
- **age** < 60
- lower BP
- normal glucose
- **minimal EIC on CT**
- (high ASPECTS)
- no leukariosis
- **moderate - severe deficits**
- small - moderate clot burden
- no NINDS protocol violations

“Less favorable”

- > 180min
- age > 80
- very high BP
- high glucose
- extensive CT scan Δ
- (low ASPECTS)
- severe leukariosis
- very mild deficits
- heavy clot burden
- NINDS violation

Stroke

Thrombolysis Evidence Base

IST3 – International Stroke Trial – 3 (2013)

Thrombolysis in acute ischaemic stroke

Baseline characteristics

- n = 3035 multicenter randomised controlled trial, acute ischemic stroke
- Rx rtPA (alteplase) thrombolysis < 6hrs post onset
- 2003 License 0-3hrs, <80yr, NIHSS 6-25 2%
- 2008 ECASS3 0-4.5hr, <80yr, NIHSS 6-25 12.7%
- > 80yrs 53%
- > 4.5hrs 33%

Reference: IST-3 Lancet Neurol 2013; 12: 768 -776

Stroke

Thrombolysis Evidence Base – IST3 (2013)

Acute Ischemic Stroke - Thrombolysis selection

Rx < 3rs from onset

- age no barrier
- robust evidence of benefit
- benefit across broad range of strokes

Rx 3 - 4.5hrs from onset

- no benefit for “uncertain” pts
- use strict ECASS3 criteria
 - 18-80yrs
 - no significant improvement
 - exclusions:
 - Phx stroke + DM
 - previous stroke/trauma

Reference: IST-3 Lancet Neurol 2013; 12: 768 -776

Stroke

Thrombolysis Evidence Base

IST3 – International Stroke Trial – 3 (2013)

Conclusion

“IST-3 provides evidence that thrombolysis with iv alteplase (rtPA) for acute ischemic stroke does not affect survival, but does lead to statistically significant, clinically relevant improvements in functional outcome and health related quality of life (QOL) that are sustained for at least 18 months”

Reference: IST-3 Lancet Neurol 2013; 12: 768 -776

Questions

END

Stroke

Thrombolysis Evidence Base – IST3 (2013)

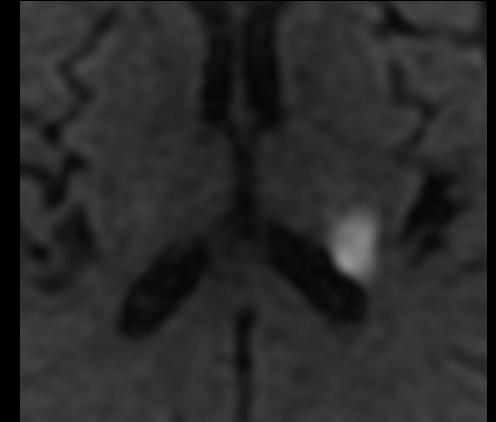
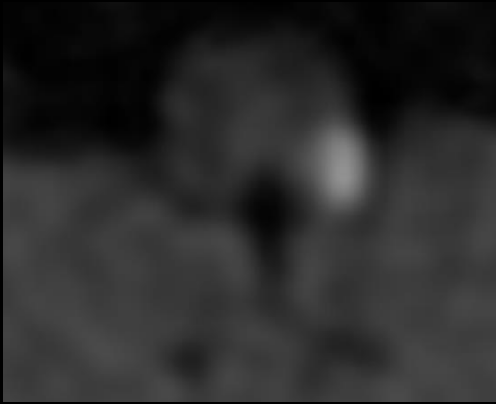
Acute Ischemic Stroke – results 0 - 6hrs

	rTPA	control
Outcome: Alive and independent	37%	35%
Symptomatic ICH	7%	1%
Mortality 7 days	11%	7%
Mortality 6 months	27%	27%

Reference: IST-3 Lancet Neurol 2013; 12: 768 -776

TIA

MRI DWI lesion Frequency in Patients with TIAs_(pooled data n = 818)



TIA Symptom Duration (hrs)

MRI DWI Restriction (%)

0–1	33.6%
1–2	29.5%
2–3	39.5%
3–6	30.0%
6–12	51.1%
12–18	50.0%
18–24	49.5%

AHA/ASA Statement: Definition & Evaluation of TIA_Stroke 2009

TIA

Summary Recommendations for Resolved Cerebral Ischemic Syndromes (TIA)

1. TIAs are sudden brief episodes of focal neurological dysfunction resulting from focal cerebral ischemia **not** associated with permanent cerebral infarction.
2. TIAs are traditionally defined as “**sudden onset, focal neurologic deficits of presumed vascular origin lasting < 24 hours**”.
3. Recent studies from many groups worldwide have demonstrated that this arbitrary time threshold was too broad. **30% - 50%** of classically defined TIAs show brain injury on diffusion-weighted MRI.
4. Several groups have proffered neuroimaging-based, operational definitions of TIA such as “**a brief episode of neurological dysfunction caused by focal brain or retinal ischemia, with clinical symptoms typically lasting < 1 hour, without evidence of acute infarction**”
5. These newer definitions have not yet been formally considered or adopted by authoritative organizations.
6. Stroke and TIA are a spectrum of brain ischemia. Each are markers of reduced cerebral blood flow and an increased risk of disability and death. TIAs offer an opportunity to initiate treatment that can forestall the onset of permanently disabling injury.

TIA

TIA Class 1 Recommendations:

1. TIA should undergo neuroimaging evaluation < 24 hours of symptom onset. MRI, including DWI, is the preferred brain diagnostic imaging modality. If MRI is not available, head CT should be performed
(Class I, Level of Evidence B).
2. Noninvasive imaging of the extracranial-intracranial vessels should be performed routinely
(Class I, Level of Evidence A).
3. Noninvasive testing of the intracranial vasculature reliably excludes the presence of intracranial stenosis and is reasonable to obtain when knowledge of intracranial steno-occlusive disease will alter management. Reliable diagnosis of intracranial stenosis requires DSA to confirm abnormalities detected with noninvasive testing.
(Class I, Level of Evidence A)
4. Suspected TIA should be evaluated as soon as possible after an event
(Class I, Level of Evidence B).

TIA

TIA Class 2 Recommendations:

1. Assessment of the extracranial vasculature may involve any of the following: Carotid Doppler/TCD, MRA, or CTA, depending on local availability and expertise (Class IIa, Level of Evidence B).
2. If only noninvasive testing is performed before endarterectomy, it is reasonable to pursue 2 concordant noninvasive findings; otherwise, DSA should be considered (Class IIa, Level of Evidence B).
3. Role of plaque characteristics and detection of MESs is not yet defined (Class IIb, Level of Evidence B).
4. ECG should be performed as soon as possible after TIA (Class I, Level of Evidence B). Cardiac monitoring (telemetry or Holter) is useful in patients with an unclear origin after initial brain imaging and ECG (Class IIa, Level of Evidence B).
5. Echocardiography (at least TTE) is reasonable in the evaluation of patients with suspected TIAs, especially in patients in whom no cause has been identified by other elements of the workup (Class IIa, Level of Evidence B). TEE is useful in identifying PFO, aortic arch atherosclerosis, and valvular disease and is reasonable when identification of these conditions will alter management (Class IIa, Level of Evidence B).
6. Routine blood tests (FBC, U&Es, LFTs, PTT and partial thromboplastin time, and fasting lipid profile are reasonable (Class IIa, Level of Evidence B).
7. Hospitalisation reasonable in TIA if presenting < 72 hours any of the following criteria are present:
 - a. ABCD score of ≥ 3 (Class IIa, Level of Evidence C).
 - b. ABCD score of 0-2 and uncertainty that outpatient workup can be completed < 2 days (Class IIa, Level of Evidence C).
 - c. ABCD score of 0-2 and other evidence that indicates the patient's event was caused by focal ischemia (Class IIa, Level of Evidence C).

Stroke

Imaging Ischaemia :

- cerebrovascular reserve impairment
stress brain perfusion imaging (acetazolamide)
- hypoperfusion
rest brain hypoperfusion, CBF lesion
- infarction
necrosis

Stroke

Imaging Techniques:

- CT Head C- (NECT)
- Neuroperfusion Imaging – (CTP)
- MRI Head (MRI)
- MRA extracranial carotid - intracranial COW (MRA)
- Carotid Doppler US
- CT Angiography Carotid – COW (CTA)
- Echocardiography

END