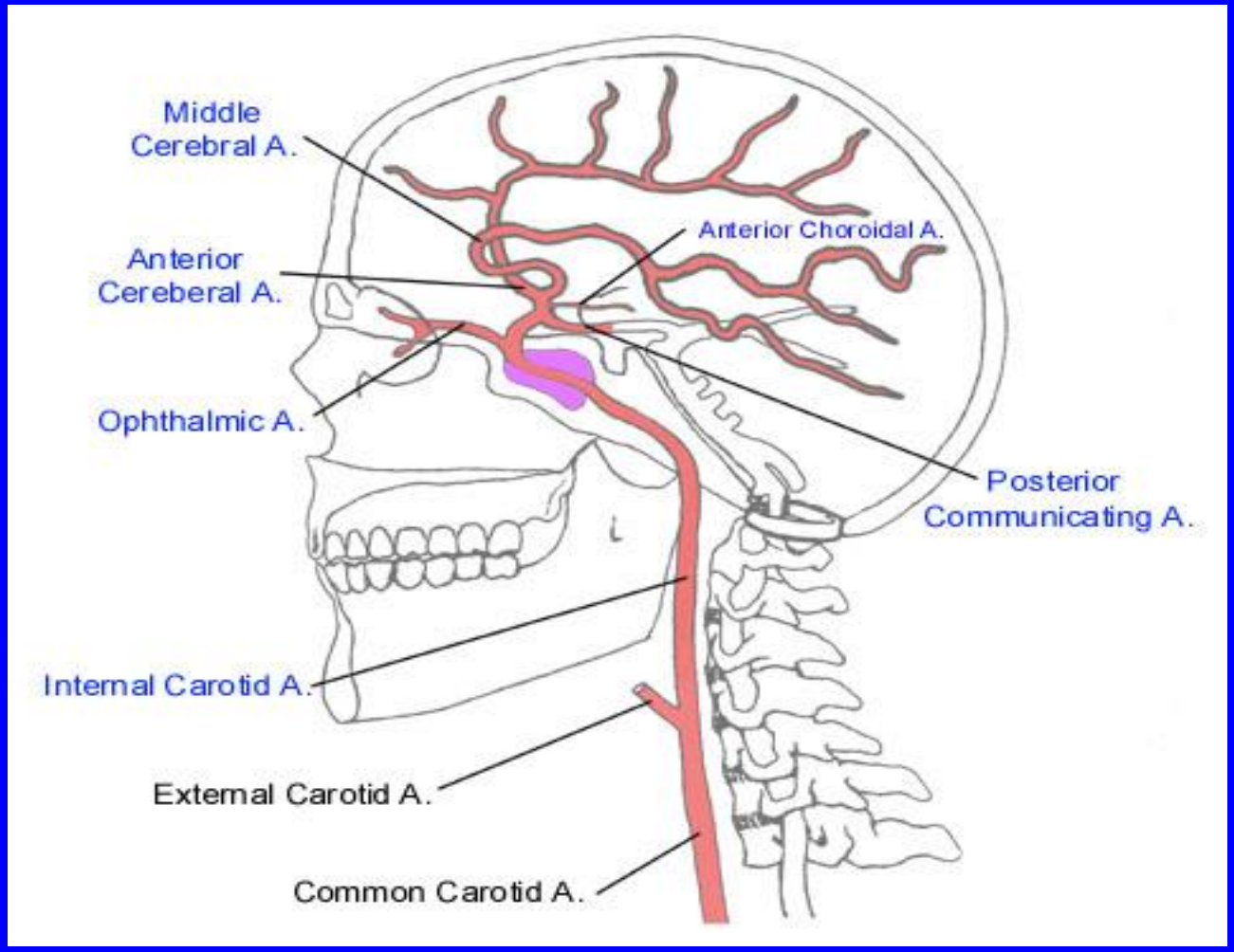
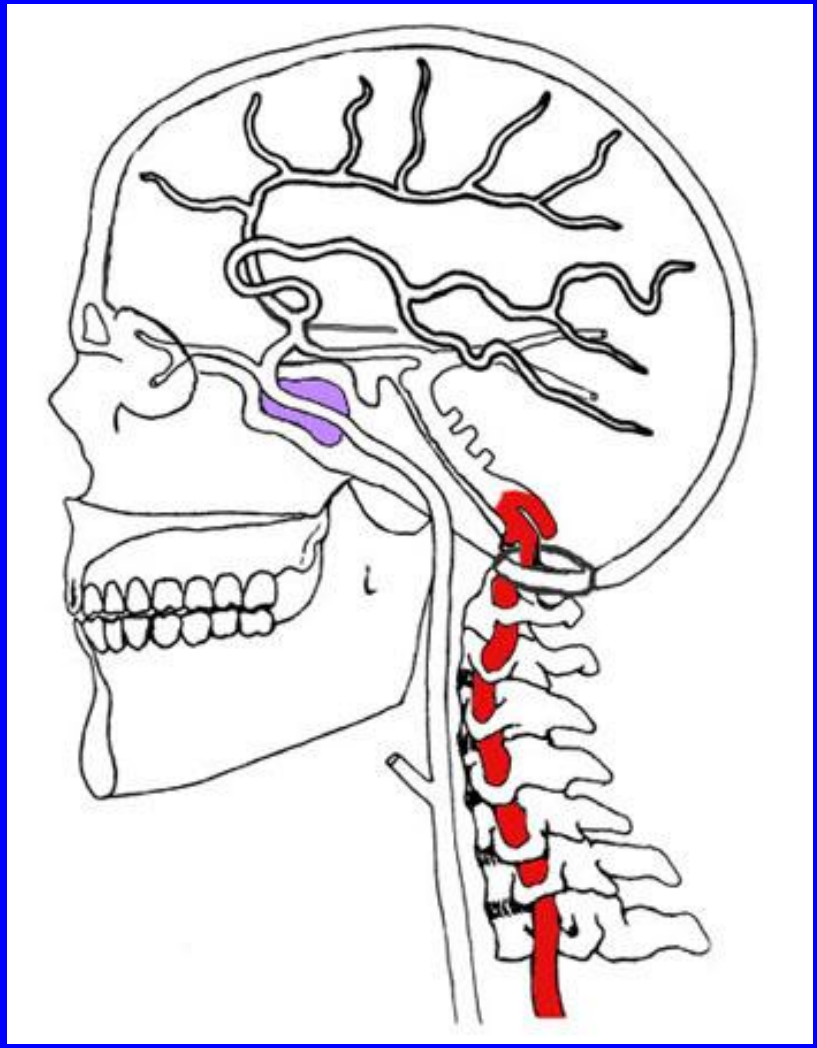
ΑΓΓΕΙΑΚΑ ΕΓΚΕΦΑΛΙΚΑ ΕΠΕΙΣΟΔΙΑ

ΚΩΤΣΗΣ ΒΑΣΙΛΕΙΟΣ, MD, PH.D, FESH.
ΑΝ ΚΑΘ ΠΑΘΟΛΟΓΙΑΣ ΑΠΘ

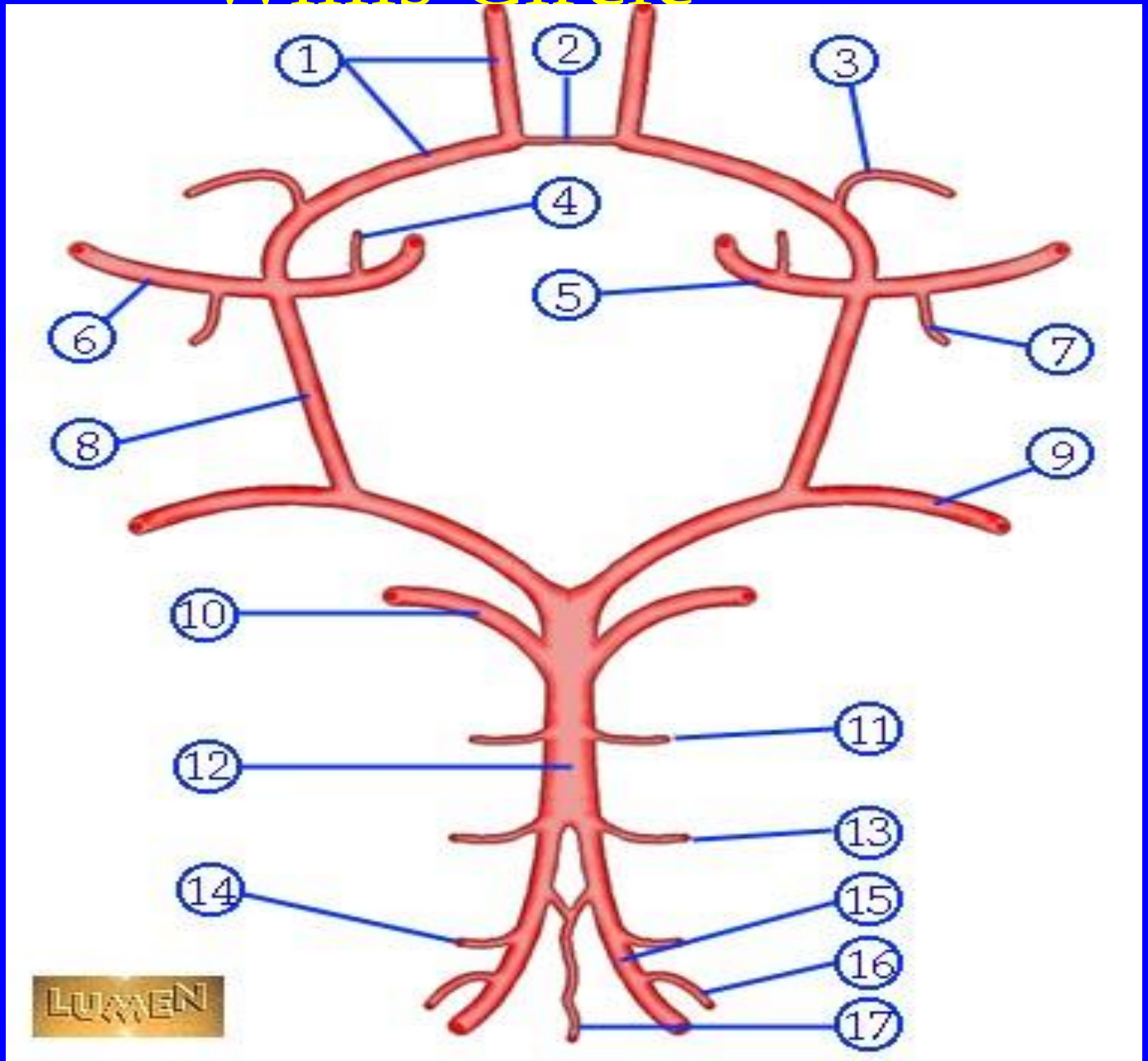
CAROTID ARTERY SYSTEM



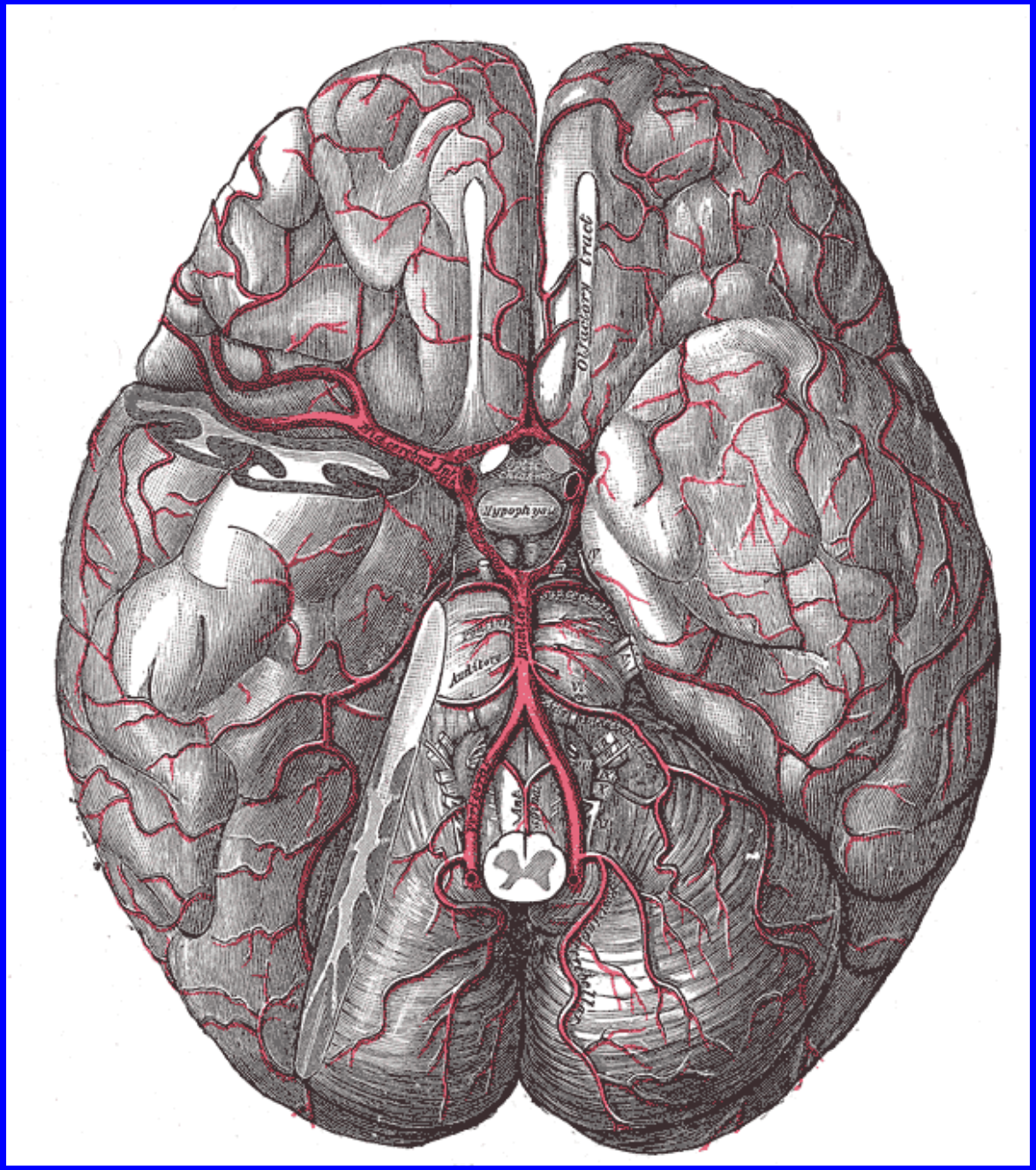
VERTEBRAL ARTERY



Willis Circle



CEREBRAL ARTERIES



ΤΑΧΙΝΟΜΙΣΗ ΤΩΝ ΑΓΓΕΙΑΚΩΝ ΕΓΚΕΦΑΛΙΚΩΝ ΕΠΕΙΣΟΔΙΩΝ

1. ΠΑΡΟΔΙΚΑ
2. ΑΙΜΟΡΑΓΙΚΑ
3. ΙΣΧΑΙΜΙΚΑ
4. ΥΠΑΡΑΧΝΟΕΙΔΗΣ ΑΙΜΟΡΑΓΙΑ
5. ΥΠΟΣΚΛΗΡΙΟ ΑΙΜΑΤΩΜΑ

Transient Monocular Blindness and Transient Ischemic Brain Attack (TIA)

- Transient monocular blindness (TMB) and transient ischemic brain attack (TIA) are focal retinal or brain deficits caused by vascular disease that clear completely in less than 24 hours.
- Most TIAs have a **duration of less than 1 hour**, with a median duration of 14 minutes in carotid-distribution ischemia and 8 minutes in vertebrobasilar ischemia.
- Atherosclerosis of cerebrovascular arteries is the most common cause of transient ischemia in older patients with risk factors for stroke. TIAs may herald cardioembolic strokes in 11% to 30% of instances, and occasionally they may be the result of hypercoagulable states, arterial dissection, arteritis, aneurysm, and arteriovenous malformation.
- Rarely a transient neurological deficit of nonvascular origin may mimic TMB or TIA, for example, seizures, migraines, tumors, and subdural hematoma, requiring a precise differential diagnosis.
- Patients who have had a TIA have a risk of stroke estimated at 24% to 29% in the first 5 years after the event. The risk is higher in the first month and highest in patients with hemispheric TIA and carotid stenosis >or=to70% luminal reduction (40% rate of stroke in 2 years). In contrast, patients of any age with isolated TMB and younger patients with TIA have a generally low risk of stroke.

TOAST Classification of Subtypes of Acute Ischemic Stroke

- Large-artery atherosclerosis (embolus/thrombosis)
- Cardioembolism (high-risk/medium-risk)
- Small-vessel occlusion (lacune)
- Stroke of other determined etiology
- Stroke of undetermined etiology
    a. Two or more causes identified
    b. Negative evaluation
    c. Incomplete evaluation

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DIAGNOSIS OF STROKE SUBTYPE

- clinical features
- brain imaging (CT/MRI),
- Cardiac imaging (echocardiography,etc.)
- duplex imaging of extracranial arteries
- Arteriography
- laboratory assessments for a prothrombotic state.

Features of TOAST Classification of Subtypes of Ischemic Stroke

Features	Subtype			
	Large-artery atherosclerosis	Cardioembolism	Small-artery occlusion (lacune)	Other cause
Clinical				
Cortical or cerebellar dysfunction	+	+	−	+/−
Lacunar syndrome	−	−	+	+/−
Imaging				
Cortical, cerebellar, brain stem, or subcortical infarct >1.5 cm	+	+	−	+/−
Subcortical or brain stem infarct <1.5 cm	−	−	+/−	+/−
Tests				
Stenosis of extracranial internal carotid artery	+	−	−	−
Cardiac source of emboli	−	+	−	−
Other abnormality on tests	−	−	−	+

TOAST, Trial of Org 10172 in Acute Stroke Treatment.

Large-artery atherosclerosis

- These patients will have clinical and brain imaging findings of either significant **(>50%) stenosis or occlusion of a major brain artery or branch cortical artery,** presumably due to atherosclerosis
- Clinical findings include those of cerebral cortical impairment (aphasia, neglect, restricted motor involvement, etc.) or brain stem or cerebellar dysfunction
- A history of intermittent claudication, transient ischemic attacks (TIAs) in the same vascular territory, a carotid bruit, or diminished pulses helps support the clinical diagnosis.
- Cortical or cerebellar lesions and brain stem or subcortical hemispheric **infarcts greater than 1.5 cm** in diameter on CT or MRI are considered to be of potential large-artery atherosclerotic origin
- Supportive evidence by duplex imaging or arteriography of a stenosis of greater than 50% of an appropriate intracranial or extracranial artery is needed.
- Diagnostic studies should exclude potential sources of cardiogenic embolism.
- The diagnosis of stroke secondary to large artery atherosclerosis cannot be made if duplex or arteriographic studies are normal or show only minimal changes.

Cardioembolism

- This category includes patients with arterial occlusions presumably due to an embolus arising in the heart.
- At least one cardiac source for an embolus must be identified for a possible or probable diagnosis of cardioembolic stroke.
- Clinical and brain imaging findings are similar to those described for large-artery atherosclerosis.
- Evidence of a previous TIA or stroke in more than one vascular territory or systemic embolism supports a clinical diagnosis of cardiogenic stroke. Potential large-artery atherosclerotic sources of thrombosis or embolism should be eliminated.
- A stroke in a patient with a medium-risk cardiac source of embolism and no other cause of stroke is classified as a possible cardioembolic stroke.

Cardiac sources are divided into high-risk and medium-risk groups based on the evidence of their relative propensities for embolism

High-risk sources

- Mechanical prosthetic valve
- Mitral stenosis with atrial fibrillation
- Atrial fibrillation (other than lone atrial fibrillation)
- Left atrial/atrial appendage thrombus
- Sick sinus syndrome
- Recent myocardial infarction (<4 weeks)
- Left ventricular thrombus
- Dilated cardiomyopathy
- Akinetic left ventricular segment
- Atrial myxoma
- Infective endocarditis

Medium-risk sources

- Mitral valve prolapse
- Mitral annulus calcification
- Mitral stenosis without atrial fibrillation
- Left atrial turbulence (smoke)
- Atrial septal aneurysm
- Patent foramen ovale
- Atrial flutter
- Lone atrial fibrillation
- Bioprosthetic cardiac valve
- Nonbacterial thrombotic endocarditis
- Congestive heart failure
- Hypokinetic left ventricular segment
- Myocardial infarction (>4 weeks, <6 months)

Small-artery occlusion (lacunar infarcts)

- The patient should have one of the traditional clinical lacunar syndromes and should not have evidence of cerebral cortical dysfunction.
- A history of diabetes mellitus or hypertension supports the clinical diagnosis.
- The patient should also have a normal CT/MRI examination or a relevant brain stem or subcortical hemispheric **lesion with a diameter of less than 1.5 cm demonstrated**.
- Potential cardiac sources for embolism should be absent,and evaluation of the large extracranial arteries should not demonstrate a stenosis of greater than 50% in an ipsilateral artery.

Acute stroke of other determined etiology.

- This category includes patients with rare causes of stroke, such as nonatherosclerotic vasculopathies, hypercoagulable states, or hematologic disorders.
- Patients in this group should have clinical and CT or MRI findings of an acute ischemic stroke, regardless of the size or location.
- Diagnostic studies such as blood tests or arteriography should reveal one of these unusual causes of stroke.
- Cardiac sources of embolism and large-artery atherosclerosis should be excluded by other studies.

Stroke of undetermined etiology.

- In several instances, the cause of a stroke cannot be determined with any degree of confidence. Some patients will have no likely etiology determined despite an extensive evaluation.

- In others, no cause is found but the evaluation was cursory. This category also includes patients with two or more potential causes of stroke so that the physician is unable to make a final diagnosis. For example, a patient with a medium-risk cardiac source of embolism who also has another possible cause of stroke identified would be classified as having a stroke of undetermined etiology.

- Other examples would be a patient who has atrial fibrillation and an ipsilateral stenosis of 50%, or the patient with a traditional lacunar syndrome and an ipsilateral carotid stenosis of 50%.

Rationale for Use of Imaging in Acute Cerebrovascular Disease

The clinician should follow two basic pathways when ordering imaging tests in patients with acute cerebrovascular disease:

- Imaging of the parenchyma (brain, spinal cord)
- Imaging of the vessels (extracranial, intracranial)

Imaging of the brain provides information that can guide patient treatment by

- - Identifying the lesion (is it a stroke?)
- - Determining the type of stroke (ischemic infarct or hemorrhage?)
- - Localizing the stroke (where is it?)
- - Quantifying the lesion (how large is it?)
- - Determining the age of the lesion (how old is it?)
- Pertinent answers to these questions help in formulating a diagnosis, devising a plan of action, and advancing a prognosis.

BRAIN IMAGES TEQNIQUES FOR TIA

- **CT scan of the head**

to exclude a rare lesion such as a subdural hematoma or brain tumor responsible for symptoms.

- CT may reveal an area of brain infarction appropriate to TIA symptoms in 29% to 34% of patients, a finding that may influence subsequent management, especially the timing of an eventual carotid endarterectomy
- CT of the head has only a limited role in evaluation of patients with TMB or vertebrobasilar TIAs, as subdural hematoma or brain tumor are not known to present with transient symptoms resembling posterior circulation ischemia.

- MRI

- ✓ may be considered when a CT scan fails to substantiate the clinical diagnosis
- ✓ if additional diagnoses require confirmation or exclusion of patients with TMB.
- ✓ There is also advantage in identifying lesions such as subdural hematoma that may be isodense with surrounding parenchyma on CT imaging.

Imaging of the Vessels in TIAs

- **Carotid duplex or Doppler ultrasonography:** a noninvasive imaging of extracranial carotid, vertebrobasilar, and major intracranial vessels
- **Contrast-enhanced CT scanning of the cervical vessels with helical methodology**, in particular, images the arterial wall as well as the lumen and may be helpful as a screening tool in centers where it is available.
- **Radiographic arteriography**

➢ best defines surgically remediable lesions in the accessible, extracranial segment of the carotid artery. Radiographic arteriography is generally recommended for a symptomatic patient when noninvasive tests indicate >or=to70% occlusion in the appropriate carotid artery and exclusions do not apply. In some instances complete occlusion by noninvasive tests may need confirmation or exclusion by conventional arteriography. The benefit of endarterectomy have proved in patients with symptomatic arterial stenosis with >or=to70% luminal reduction as measured on cerebral arteriographic images.

➢ may also be required when a diagnosis of dissection, vasculitis, aneurysm, or embolism needs confirmation or exclusion.

BRAIN IMAGES TEQNIQUES FOR ACUTE STROKE I

- CT of the head without contrast enhancement as the initial brain imaging procedure in patients with acute stroke
- A follow-up CT of the head without contrast enhancement 2 to 7 days after stroke onset is recommended when the initial CT scan result is negative and documentation of the presence, location, and extension of the ischemic infarction is needed, or when clinically significant hemorrhagic transformation is suspected.

BRAIN IMAGES TEQNIQUES FOR ACUTE STROKE II

- MRI of the brain is not recommended for routine evaluation of patients with acute stroke. Despite its imaging advantages, MRI of the brain is not necessary to initiate emergent treatment in the majority of patients with acute stroke; when available, MRI is an appropriate imaging alternative.
- Special circumstances may co-occur in some patients (posterior fossa localization, suspicion of dissection, underlying lesion, age of cerebral hemorrhage, uncertain CT image) that drive the need to obtain an MRI image of the head. The decision must be made on an individual basis in accordance with specific clinical situations

BRAIN IMAGES TEQNIQUES FOR ACUTE STROKE III

- ✓ Imaging of cervicocerebral vessels intended to establish a probable etiology of acute stroke is generally not necessary to initiate emergent management, and the test (ultrasound, MRA, CT angiography, conventional angiography, SPECT) should not delay treatment.
- ✓ When indicated, these procedures should be tailored to specific requirements. Information on carotid or intracranial occlusive disease may guide decisions on cardiac workup, anticoagulation, or carotid endarterectomy for prevention of future stroke
- ✓ Ultrasound will generally suffice, but conventional radiographic angiography may be occasionally indicated, based on findings of noninvasive screening procedures.

Subarachnoid Hemorrhage (SAH)

- Noncontrast CT of the head is strongly recommended as the initial procedure for diagnosis of SAH.
- Selective catheter cerebral angiography is the recommended procedure for diagnosis of cerebral aneurysm as the cause of SAH.

Arteritis and Other Arteriopathies

- In patients with stroke and suspected cerebral arteritis, MRI is generally recommended, because MRI is more sensitive than CT for identifying small ischemic lesions that, being common in vasculitis, may advance the etiologic diagnosis.
- Conventional angiography is recommended to detect beading, stenosis, or aneurysm, particularly in medium and small cerebral vessels affected by vasculitis.

Dural Sinus and Venous Thrombosis

- There is general agreement in recommending MRI of the brain when thrombosis of a dural sinus, deep vein, or cortical vein is suspected as the cause of cerebral stroke. Sagittal and coronal T1-weighted images, T2 and gradient echocardiographic axial images, and three-dimensional phase-contrast or time-of-flight MRA are suggested.

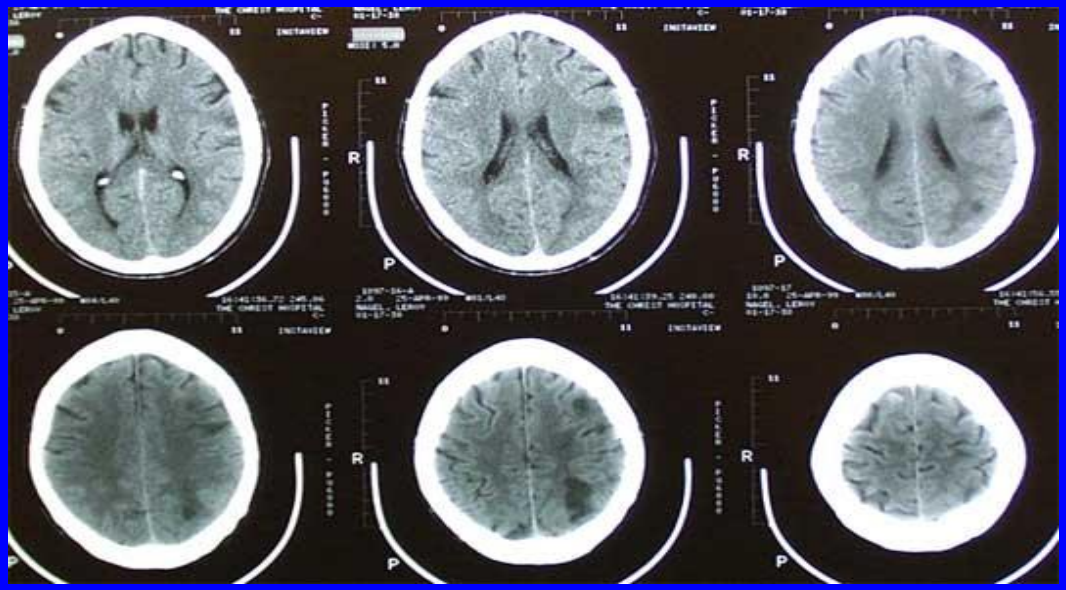
- Where MRI and MRA are not available, contrastenhanced CT of the brain and, in particular, conventional angiography are diagnostic options to be used independently or in combination to advance the diagnosis of deep vein, cortical vein, or dural sinus thrombosis

Arterial Dissection

- There is general agreement for recommending CT of the head in early evaluation of young adults with acute stroke.
- When arterial dissection is suspected, MRI/MRA of the head and neck are generally useful to screen for arterial dissection.
- Conventional radiographic angiography may be done if the diagnosis from MRI/MRA is unclear and there is strong suspicion of cervico-cerebral dissection. The procedure is technically simple and low risk in young adults.

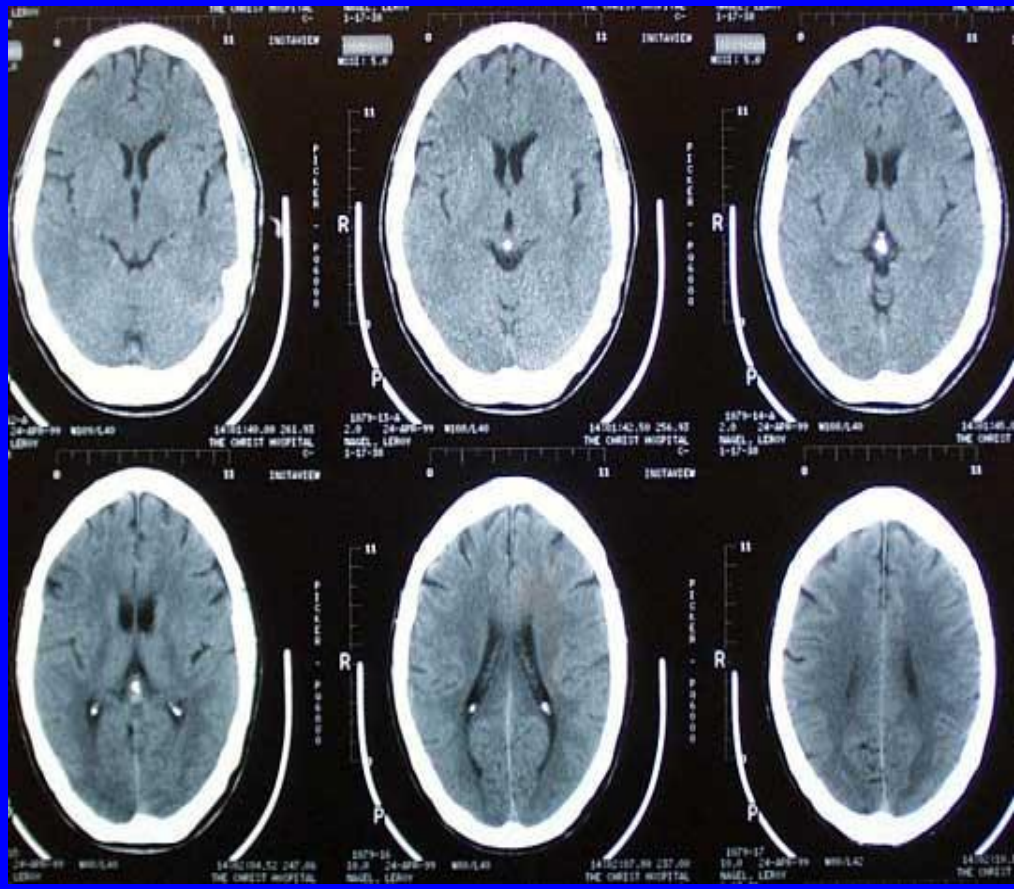
Case Study

- A 61 year old male, with acute stroke,.
- Repeat NIHSS = 3
- VF intact
- No gaze palsy
- Mild facial palsy
- Mild right arm drift
- Mild dysarthria
- Initial CT negative
- Treated with rt-PA
- Repeat CT shows areas of infarct
- Carotid U/S shows 60-80% stenosis left ICA
- Speech recommends swallowing II diet and daily checks
- Physical therapy pending
- CEA performed day 3
- Patient discharged to home on day 7 near pre-stroke baseline.

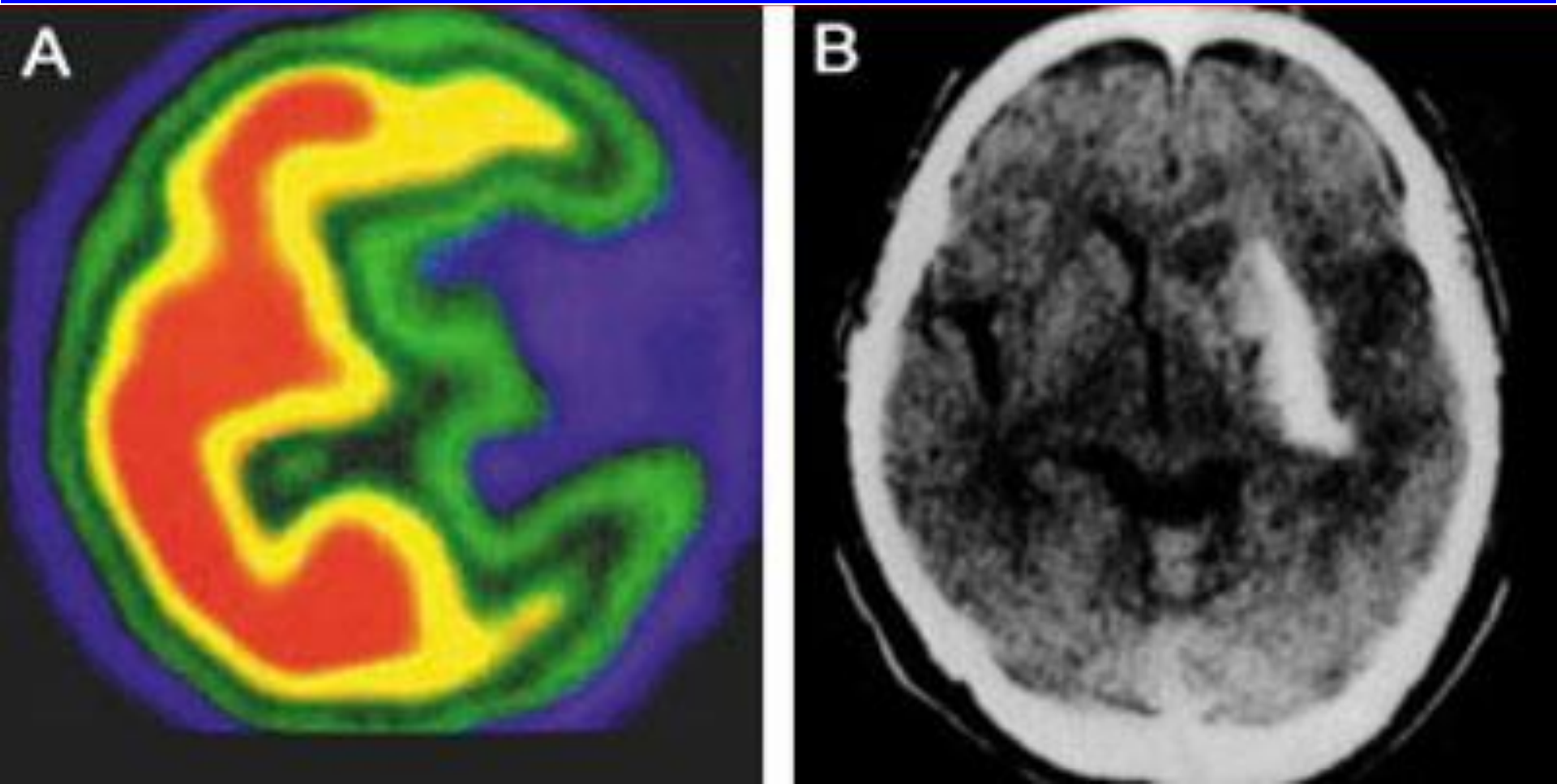


CASE

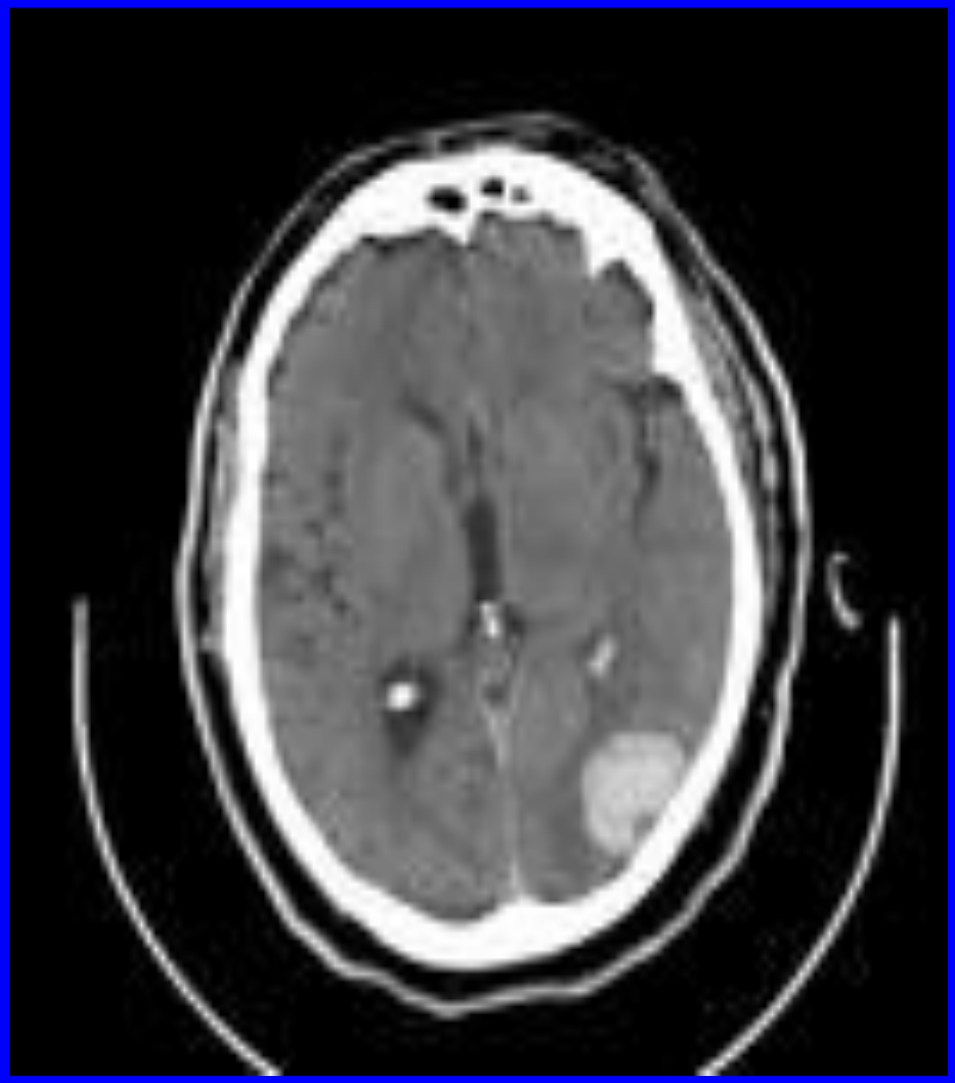
- **Case Study**
- **History:**
- A 61 year old male, with acute aphasia, right facial droop, and right sided weakness.
- **12:30** Sudden onset while working in yard.
- **12:45** Family calls 911.
- **13:05** Advanced squad evaluates neurologic deficits and glucose.
- **13:15** Squad notifies receiving hospital of possible stroke patient.
- **13:30** ED arrival. Initial evaluation by E.D. physician.
- **13:45** Stroke Team arrives. NIHSS 18.
- **14:00** CT scan performed.
- **14:15** Discuss with family and PMD.
- **14:20** Labs back: gluc 97. BP remains 150/70's. **14:20**CT reading back. (See below.) No hemorrhage or early signs of ischemia. **14:25**Checklist done. No exclusion criteria met.
- **14:30** Decision time.
- **14:35** IV rt-PA given. 0.9 mg/kg total 10% bolus - 9 mg 90% over 1 hr - 81 mg
- **15:45** Patient goes to ICU. Report personally given to ICU staff.
- **15:50** Pathway actions begin (HOB, BP parameters, aspiration precautions).



Perfusion Imaging



Double vision in a 71 year old man with intraparenchymal hemorrhage



Epidural hematoma

Old infarct in the territory of the left posterior

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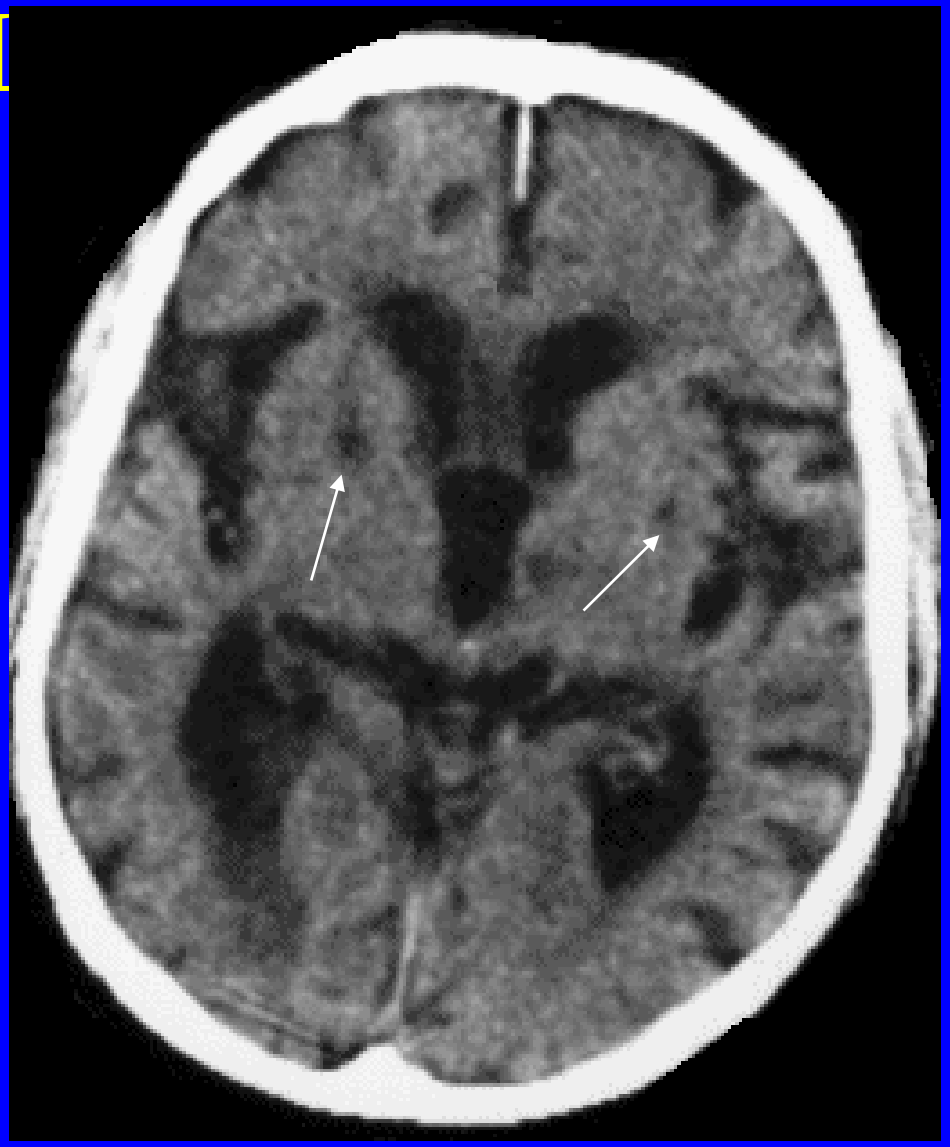
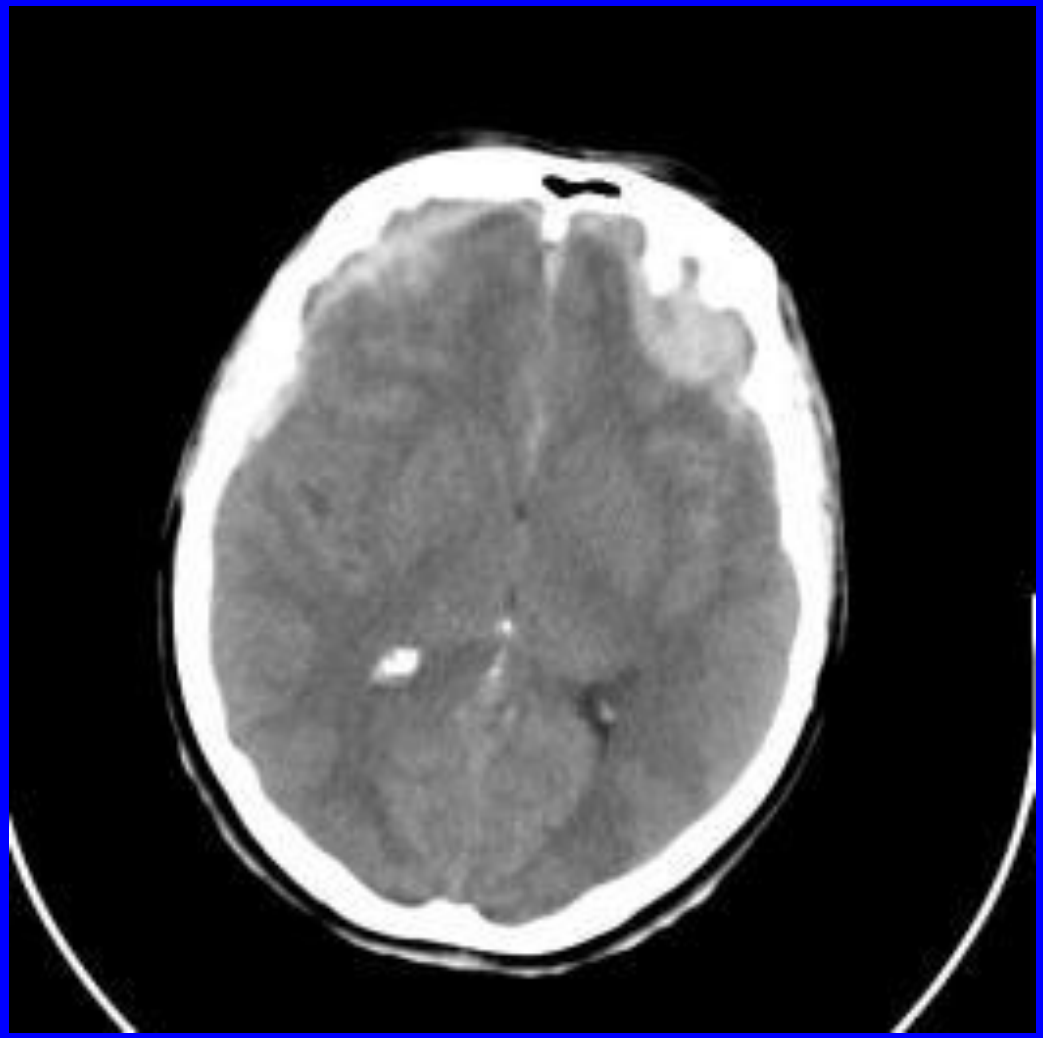


HEMORHAGE



Aneurysm, middle cerebral artery, giant