

Team Medicine



Lecture Number#18

Lecture Title:

Stroke



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Introduction:

A 56-year-old woman is brought to the ER department by her daughter complaining of sudden onset of right upper extremity weakness that began while she was watching television early this morning. The daughter became concerned when her mother was unable to talk in response to questions. Neurologic examination showed right upper extremity weakness with pronator drift and right facial nerve palsy. When questioned, the patient seems to understand what is being said but cannot clearly respond.

Definition:

A cerebrovascular accident (CVA) is defined as a sudden onset of a focal neurologic deficit.

A stroke can be caused by an obstruction in the blood flow, or the rupture of an artery that feeds the brain.

The two main types of stroke:

****Ischemic stroke:***

Ischemic stroke accounts for about 87 percent of all strokes and occurs when a blood clot, or thrombus, forms that blocks blood flow to part of the brain.

If a blood clot forms somewhere in the body and breaks off to become free-floating, it is called an embolus. This wandering clot may be carried through the bloodstream to the brain where it can cause ischemic stroke.

****Hemorrhagic stroke***

A hemorrhagic stroke occurs when a blood vessel on the brain's surface ruptures and fills the space between the brain and skull with blood (subarachnoid hemorrhage) or when a defective artery in the brain bursts and fills the surrounding tissue with blood (cerebral hemorrhage).

Both types of stroke result in a lack of blood flow to the brain and a buildup of blood that puts too much pressure on the brain.

The outcome after a stroke depends on where the stroke occurs and how much of the brain is affected. Smaller strokes may result in minor problems, such as weakness in an arm or leg. Major strokes may lead to paralysis or death. Many stroke patients are left with weakness on one side of the body, difficulty speaking, incontinence, and bladder problems.

Clinical Presentation:

Stroke should be considered in any patient who presents with acute onset of focal neurologic deficit. The specific clinical syndrome is determined by the mechanism and vascular territory affected. The blood supply to the brain is divided into major systems: the carotid (anterior) circulation and the vertebrobasilar (posterior) circulation.

The major blood vessels comprising the anterior circulation include the anterior cerebral artery (ACA) and middle cerebral artery (MCA).

Occlusion of the ACA: contralateral weakness and sensory loss in the leg more than in the upper extremity. Urinary incontinence, confusion and behavioral disturbances are common.

Occlusion of the MCA: contralateral hemiplegia, hemisensory loss and homonymous hemianopia with eyes deviated toward the cortical lesion. Dominant hemisphere involvement results in aphasia. Nondominant hemisphere involvement results in preserved speech, comprehension with confusion and apraxia.

Occlusion of the PCA: contralateral homonymous hemianopia, visual hallucinations and agnosias.

Occlusion of the major cerebellar arteries produce vertigo, vomiting, nystagmus and ipsilateral limb ataxia.

Who gets stroke?

Anyone can suffer from stroke. Although many risk factors are out of our control, several can be kept in line through proper nutrition and medical care.

Risk factors for stroke include the following:

- Age - as you get older your risk increases.
- Being male.
- A family history of stroke.
- High blood pressure.
- High cholesterol.
- Smoking cigarettes.
- Diabetes.
- Obesity and overweight.
- A previous stroke or transient ischemic attack (TIA).
- High levels of homocysteine (an amino acid in blood).
- Divorced men have a higher risk of stroke.

Heavy use of alcohol

Middle-aged women with clinical depression

Etiology:

Ischemic strokes are ultimately caused by a thrombus or embolus that blocks blood flow to the brain. Blood clots (thrombus clots) usually occur in areas of the arteries that have been damaged by **atherosclerosis** from a buildup of plaques.

Embolus type blood clots are often caused by **atrial fibrillation** - an irregular pattern of heart beat that leads to blood clot formation and poor blood flow.

Hemorrhagic strokes can be caused by uncontrolled high blood pressure, a head injury, or **aneurysms**. High blood pressure is the most common cause of cerebral hemorrhage, as it causes small arteries inside the brain to burst. This deprives brain cells of blood and dangerously increases pressure on the brain.

Aneurysms - abnormal blood-filled pouches that balloon out from weak spots in the wall of an artery - are the most common cause of subarachnoid hemorrhage. If an aneurysm ruptures, blood spills into the space between the surfaces of the brain and skull, and blood vessels in the brain may spasm. Aneurysms are often caused or made worse by high blood pressure.

Doctor's Notes:

**The Dr. explained the lecture without using his PowerPoint presentation.*

- Stroke is caused either by a hemorrhage or an ischemia.
- The majority of strokes are due to ischemia, which means there is a deprivation in the blood supply to one area of the brain.
- The brain is different than any other organ in the body; it has to be supplied by blood and glucose consistently because there are no O₂ and glucose storages in the brain. No blood supply to the brain means there is no oxygen reaching the brain > death.
- The area surrounding the stroke is called the penumbra. It is a salvageable area because of the collateral. The penumbra will be lost in a few hours if there were no intervention.

Acute Stroke Treatment:

- In the past, the term cerebrovascular accident was used to describe a stroke because it couldn't be managed or treated.
- There is now a treatment for stroke and can make the stroke volume smaller if we act quickly.
- In the late 80's, patients presented with MI or blood vessel occlusion were given TPA "Tissue plasminogen activator" to dissolve the blood clot, which is different than antiplatelets and anticoagulants that prevent blood clot formation. Physicians did a randomized study to patients who presented with MI within 6 hours; they were classified into two groups; those who took TPA and those who took placebo. The results showed that the group who received TPA had less volume of heart attack and this was the acute treatment for myocardial infarction. The same study was made to patients who presented with stroke within 6 hours but the results were negative, so they did another study and decreased the time window for TPA administration to **four and half hours** and it worked. Administering TPA beyond four and half hours will cause bleeding so physicians should be certain about the onset of symptoms.
- CT scan is the best modality to differentiate between ischemic and hemorrhagic stroke before giving TPA to the patient.
- So before the administration of TPA, the physician should check the patient's (Inclusion, Exclusion criteria and the onset duration of the symptoms).
- Giving TPA to a patient with bleeding or even a history of prior bleeding is contraindicated.
- The majority (95-97%) of patients with stroke present after four hours.
 - The two options for acute stroke treatment are:
 - TPA within 4 and a half hour. (Only in ischemic stroke).
 - The mechanical thrombolysis within 8 hours of the onset of symptoms.
- Any vascular surgeon or a neurosurgeon who received 2 years training in surgical intervention is allowed to do this procedure. "Recanalization".
- Some patients have good collaterals while other have poor ones, this affects the progress of a patients' condition with a huge stroke.

Doctor's Notes:

Etiology:

- Once you know the etiology of a small stroke, you can prevent the recurrence of a huge one.
- Stroke can be due to a problem in the blood itself "hypercoagulable state", the heart, the large vessels or the small ones.

Hypercoagulable State:

- EX: A 70-year-old patient presented with stroke will probably have a heart problem, while a young patient presented with stroke will probably have thrombophilia. [Ask about the hypercoagulable profile "Protein S activity, Protein C activity, factor 5 Leiden/Prothrombin Gene Mutation (molecular testing) and Antithrombin 3, Lupus Anticoagulant"]
- Ex: When a normal young patient presents with stroke, always think of sickle cell disease. "In sickle cell Anemia, small blood vessels get infarcted restricting the blood supply to the brain causing a stroke." Also, think about medications; especially OCP in young female patients.
- Patients with hypercoagulable states should receive anticoagulants like warfarin.

Heart:

- **Atrial Fibrillation is considered a major cause of stroke in the elderly.** [The atrium isn't pumping blood so it will become stagnant and form clots that will be transported to the brain].

- Randomized double blind studies were made to determine the anticoagulants effect on patients with A-fib. Up to 70% of recurrent strokes can be prevented with Warfarin.
- Stroke may develop from **endocarditis** [small clots or pieces of the infection breaking off and traveling to the brain]. We use antibiotics to treat endocarditis not anticoagulants because these small septic emboli will invade blood vessels and weaken them forming what we call "mycotic aneurysms" that will rupture in case anticoagulants were used.
- Other heart related causes include **prosthetic valves** [prescribe anticoagulants and keep the INR higher than usual "2.5-3.5" because mechanical valve prostheses are considered thrombogenic.] and mitral stenosis.
- Low ejection fraction. Also give Warfarin.

- **Patent formal ovale** is considered a normal variable among people (20% of the population). A patent foramen ovale is often discovered during tests for other problems. Learning that you have a PFO is understandably worrisome, but most people never need treatment for this disorder. [A patent foramen ovale (PFO) is a hole in the heart that didn't close the way it should after birth.] "They used to preform open-heart surgeries on patients with PFO without any evidence-based studies that it is harmful or it could cause a stroke." **Paradoxical Emboli** is when a patient with DVT and PFO has an emboli which transported from the right side of the heart to left side (because of the PFO), and then the emboli causes a stroke in the brain.

Doctor's Notes:

- Large Blood Vessels (Extra cranial):

If a Patient presents with 80% carotid stenosis [Carotid artery problems become more common as people age. The disease process that causes the buildup of fat and other material on the artery walls is called atherosclerosis, popularly known as “hardening of the arteries.” The fatty deposit is called plaque while the narrowing of the artery is known as stenosis]. A carotid endarterectomy is performed to prevent stroke. [Two large clinical trials supported by the National Institute of Neurological Disorders and Stroke (NINDS) have identified specific individuals for whom the surgery is highly beneficial when performed by surgeons and in institutions that can match the standards set in those studies].¹

Angioplasty and stenting is now replacing carotid endarterectomy. (Less invasive and same results).

Surgery is only used when more than 70% of the carotid artery is stenosed. Otherwise aspirin is recommended.

Controlling risk factors of atherosclerosis is very important in prevention.

- Large Blood Vessels (Intracranial):

Atherosclerotic stenosis of the major intracranial arteries (Internal carotid artery middle cerebral artery, vertebral artery, and basilar artery) is an important cause of ischemic stroke. Stenosis of these arteries is really bad; it has the worst prognosis among the other disease. Based on a randomized clinical trial of warfarin and aspirin, Patients on anticoagulants had a higher mortality rate. As a result, patients with stenosis of the major intracranial arteries were given **aspirin** as a treatment. In addition to that, they had to control their HTN, Diabetes, stop smoking and modify their lifestyle.

- Smoking, obesity, eating unhealthy food and living a sedentary lifestyle are all considered risk factors for heart disease and stroke.

- Simple public health measures such as [banning smoking in public places, adding fluoride to drinking water, stopping pollution ..] can prevent a lot of diseases.

- After doing a randomized clinical trial “Evidence- Based Medicine”, **performing stenting in patients with stenosis of the major intracranial arteries showed high mortality.**

- Small Blood Vessels (Intracranial):

- HTN causes small blood vessel disease “Atherosclerotic Stenosis”. Aspirin, risk factor modification and of course controlling blood pressure is the way to prevent strokes.

References:

USMLE Step 2 CK [KAPLAN].

Crosta, P..N.p.. Web. 29 Mar 2014. <<http://www.medicalnewstoday.com/articles/7624.php>>.

1). N.p.. Web. 29 Mar 2014. <<http://www.strokecenter.org/patients/stroke-treatment/carotid-endarterectomy/>>.

Useful Links:

<http://www.youtube.com/watch?v=uLJewzJcCZ0>

<http://www.youtube.com/watch?v=Ft2PIgBdXj8>

SLIDES:

The dr skimmed the slides very fast ..but read them carefully just in case

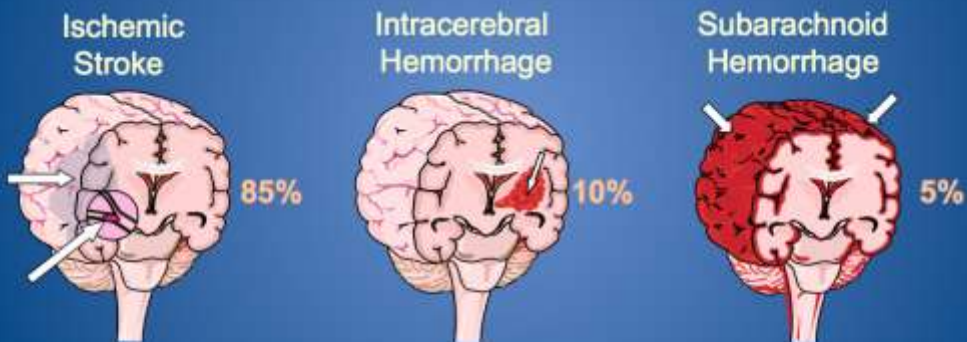
ACUTE STROKE TREATMENT: An introduction

Nov. 19th 2012



Dr. Fawaz Al-hussain FRCPC, MPH
Neurology- College of Medicine
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TYPES OF STROKE



Stroke Treatment:

Primary Stroke Prevention

Acute Stroke Treatment

Secondary Stroke Prevention

Stroke Rehabilitation

Primary stroke prevention is to prevent stroke before it happens, even if there are no risk factors.

Propper lifestyle , exercise and low fat diet ..etc

Acute Stroke Treatment

↓

Ischemic

Modalities of Acute Stroke Treatment:



IV t-PA (standard)



IA t-PA



Mechanical Disruption



Surgical Rx (old)

Inclusion and Exclusion criteria are important.

NINDS+ ECASS III)) IV t-PA

Inclusion criteria:

- **Clinical Dx of stroke**
- Stroke onset < 270 minutes
- Age is > or = 18

Exclusion criteria:

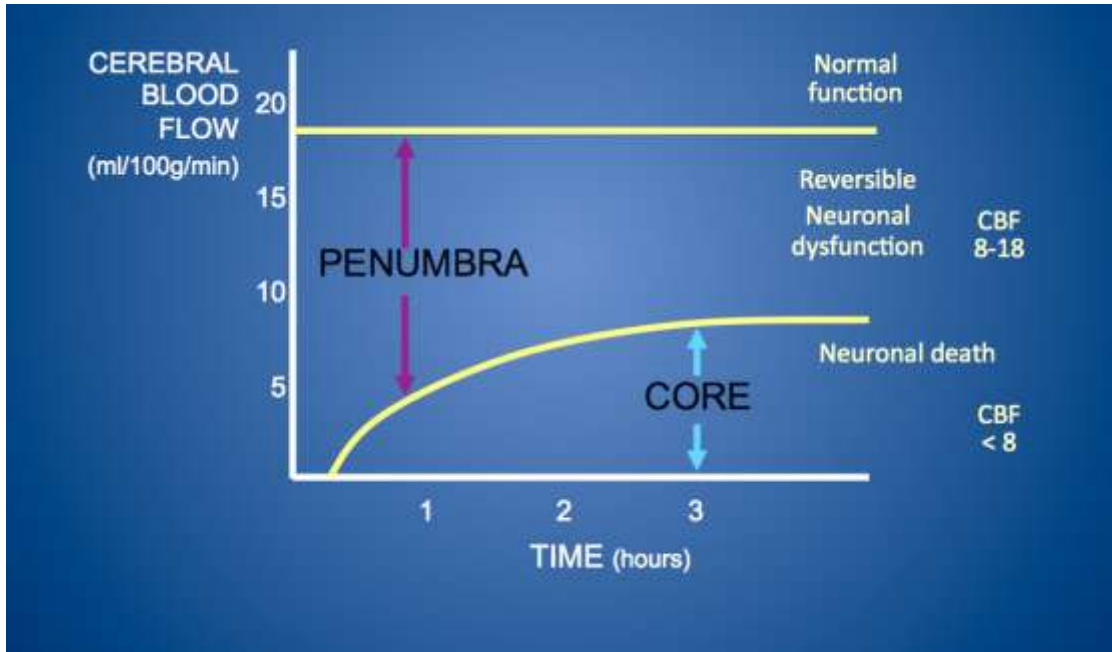
- Intracranial Hge in imaging or clinical presentation suggests SAH
- Active/ recent internal bleeding or on warfarin with INR > 1.7 or platelets < 100K
- Serum Glucose <50 or > 400
- Systolic BP > 185 or diastolic >110
- Recent MI (3/52)
- Recent (2/52) major surgery or trauma
- Recent arterial puncture at non-compressible site

NINDS+ ECASS III)) IV t-PA

- Stroke onset: timing of first neurological deficit OR last time pt was seen well
- TIA: has to end with complete neurological recovery

IV t-PA (alteplase)

- 0.9 mg / kg to a maximum of 90 mg
- 10% bolus over 1 minute then infuse rest over 60 minutes
- Hold infusion and re-evaluate the pt in case of HTN (S>185,D>110), sudden headache, or sudden reduction in LOC



Stroke Penumbra:
The target of acute stroke Rx!!

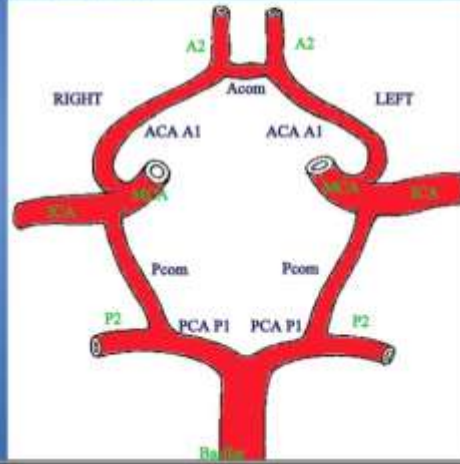


Cranial Collateral Arteries: Penumbra suppliers

External:



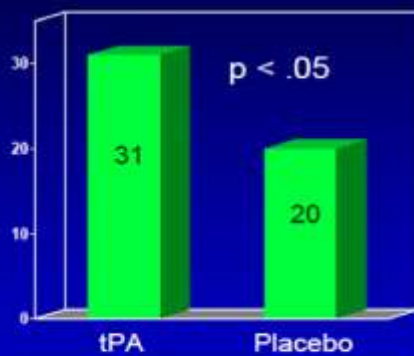
Internal:



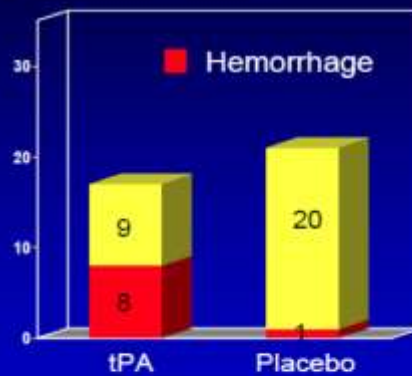
Outcome with: IV t-PA (NINDS)

New England Journal, 1995

NINDS tPA Stroke Trial



NIHSS Excellent Recovery (%)

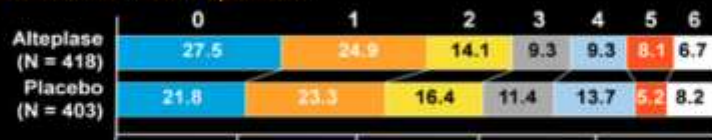


Total Death Rate (%)

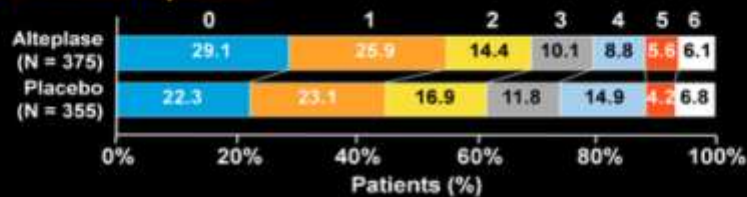
Outcome with: IV t-PA (ECASS III)

ECASS 3

A. Intention-to-Treat Population



B. Per-Protocol Population



3-month visit
 $P = 0.02$ for both groups
Adjusted for baseline NIHSS and onset to time of treatment (OTT)

IA t-PA

PROACT II trial (published 1998):

- A small study with 40 pts actively included
- Safety and recanalization rate with IA rpro-urokinase for proximal MCA stroke within 6 hrs compared to placebo → significant increase in recanalization ($p < 0.01$) but ↑ hemorrhagic transformation (15.4% vs. 7.1%)

→ Suggested superiority of IA thrombolytics delivery

IA t-PA

Interventional Management of Stroke (IMS-III) trial:

- Intervention:
 - 0.6 mg IV t-PA over 40 minutes
 - + Endo-arterial intervention → < 22 mg IA t-PA over 2 hrs
 - OR thrombus removal device
 - OR IA t-PA with US energy
- Control:
 - active with IV t-PA (standard protocol)
- **Trial is still ongoing**

Endoarterial Mechanical Disruption

Merci Retriever:

first FDA approved device



Increased recanalization rate and secondary clinical outcome when used for large cerebral arteries

	mRS 0-2	mRS 3	mRS 4-5	Dead
Recanalized	39%	12%	18%	30%
Non-recanalized	3%	10%	13%	73%

Endoarterial Mechanical Disruption

Penumbra system: FDA approved



- It does: clot suctioning
- Similar rates of recanalization and clinical outcomes to Merci retriever

Endoarterial Mechanical Disruption

3rd Generation of devices

Solitaire Device:



Solitaire was superior to Merci in Swift trial

Trevo retriever:

Trevo was superior to Merci in Trevo II trial



Endoarterial thrombolysis: Combined IA and Mechanical disruption

General recommendation:

- For M1 (MCA) clot
- For Basilar artery clot
- In certain cases where IV t-PA can not be given
e.g. patient is on warfarin or recent MI

Limitations:

- Time (*should not delay IV t-PA initiation*)
- Expertise
- ? Costs

KEY TIME INTERVALS

- Perform an initial patient evaluation within 10 minutes of arrival in the ER
- Notify the stroke team within 15 minutes of arrival
- Initiate a CT scan within 25 minutes of arrival
- Interpret the CT scan within 45 minutes of arrival
- Ensure a door-to-needle time for IV rt-PA within 60 minutes from arrival

Recommended strategies:

- Advance hospital notification by EMS
- Rapid triage and stroke team notification
- Single call activation system
- Rapid access to CT and rapid interpretation
- Rapid laboratory testing (point of care)
- Mix t-PA a head of time
- Team-based approach

Barriers for Acute Stroke Therapy

- Late patient presentation to ER (In USA; only 30% present within t-PA window)
- **Poor stroke recognition and delayed triage at ER (mainly for un-usual stroke presentations)**
- Lack of appropriate infrastructure
- Lack of acute stroke expertise
- Presence of a contra-indication
- Difficulty in getting patient's or family's verbal consent

Acute Ischemic Changes in CT

Loss of gray-white
matter
differentiation and
sulcal effacement



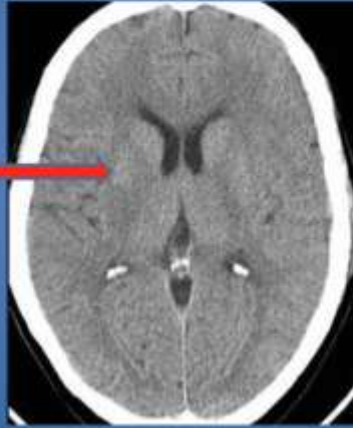
Acute Ischemic Changes in CT



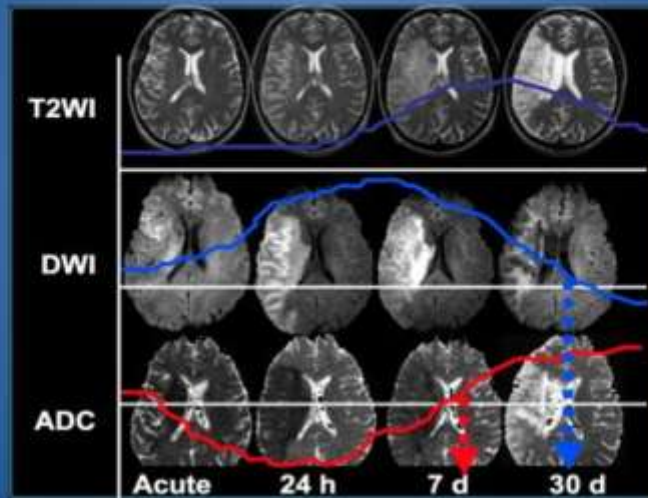
Acute Ischemic Changes in CT

A 45 yr old male with weakness in Lt side for 2 hrs

Obscuration of
lentiform nucleus



Acute Ischemic Changes in MRI



Case (1):



A 60 y.o lady with acute stroke
few hrs post IV t-PA .

She is known with HTN and
controlled DM-2

Oral-lingual angioedema: Orolingual angioedema (OA) is an unappreciated complication of acute stroke treatment with recombinant tissue plasminogen activator (rt-PA). It has been described in 2% of patients receiving thrombolysis, and it seems that patients taking angiotensin-converting enzyme inhibitors are especially at risk. Even though the presentation is generally unilateral and limited to lips and tongue, an extension of edema to the oropharynx may lead to life-threatening upper airway obstruction.

Case (2):

- 21 y. o man, a university student presented to ER with Left sided throbbing headache and mild expressive aphasia.
- Nothing else.
- NIHSS: 2
- PMHx: Migraine



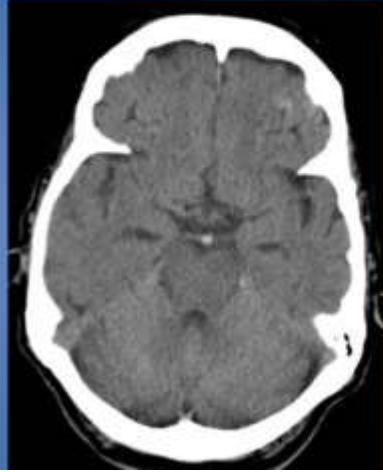
Acute left MCA (upper division) ischemic stroke with (N) CT brain.

Case (3):

A 53 y/o male with sudden reduction in LOC, jerking in 4 limbs, and difficulty in breathing.

→ Got intubated in ER then CT brain was done

PMHx: smoker, HTN



Acute Basilar artery stroke.



Summary:

✚ Types of stroke:

- Ischemic stroke.
 - Hemorrhagic stroke.
- ❖ The majority of strokes are due to ischemia.
 - ❖ The penumbra (the area surrounding the stroke) will be lost in a few hours if there were no intervention.
 - ❖ CT scan is the best modality to differentiate between ischemic and hemorrhagic stroke before giving t-PA to the patient.
 - ❖ Giving t-PA to a patient with bleeding or even a history of prior bleeding is contraindicated.

✚ Etiology:

- Patients with hypercoagulable states should receive anticoagulants like warfarin.
- Atrial Fibrillation is considered a major cause of stroke in the elderly.
- Stroke may develop from endocarditis or prosthetic valves.

✚ Acute stroke treatment:

- IV t-PA
- IA t-PA
- Mechanical Disruption
- Surgical Rx



Questions:

1) Which of the following is the most important risk factor for stroke?

- a- DM
- b- HTN
- c-smoking
- d- obesity

2) Patient came to ER complaining of ipsilateral facial dysesthesia, dysarthria, contralateral loss of pain and temperature sensation in the trunk and limbs, ipsilateral loss of taste, diplopia and dysphagia. His examination revealed truncal ataxia and nystagmus.

Radiological study confirmed the diagnosis as STROKE. Which artery is most likely affected?

- a- Anterior cerebral artery.
- b- Middle cerebral artery.
- c- Posterior cerebral artery.
- d- Vertebral artery.

3) Thrombolytic medication is given in acute ischemic stroke within:

- a- 3hrs
- b- 5hrs
- c- 7hrs
- d- 24hrs

1	B
2	B
3	A