



Lecture:

Ischemic Cerebrovascular Disease

Dr. Eyad M. Hussein

MD, Ph.D of Neurology
Consultant in Neurology Department,
Nasser Hospital,
Assistant Professor,
Faculty of Medicine, Islamic University
Faculty of Dentistry, University of Palestine

Cerebral Blood Flow

- ❖ **Cerebral blood flow (CBF):** is the blood supply to the brain in a given time.
- ❖ **Normal CBF:** 750-1000 ml/min "20% of the cardiac output". 50-54 ml of blood per 100 g of brain tissue per min. * الـ brain بشكل 1.2 من دقه الدم ما يقارب (و 1000)
- ❖ **Ischemia:** results if blood flow to the brain below 18-20 ml per 100 g of brain tissue per min.
- ❖ **Tissue Death:** occurs if flow decreased below 8-10 ml per 100 g of brain tissue per min. هتوفى النسيج



Brain Autoregulation

- The brain is very sensitive to over and under perfusion.
- Cerebral autoregulation refers to the physiological mechanisms that maintain blood flow at an appropriate level during changes in blood pressure.

Physiological mechanisms of autoregulation:

- **Metabolic regulation.**
- **Myogenic regulation.**
- **Neurogenic regulation:** by sympathetic and parasympathetic NS

Blood supply of the brain

Blood supply of the brain formed of two main system:

- ✓ 1. Carotid system *main system*
- ✓ 2. Vertebrobasilar system

* 180 ml خلايا الدماغ يتلقى supply من Carotid
 * ICA حيدخل عبر carotid canal لاجل cavernous sinus ويتوزع ك 5 branches
 * كيف فزعه بين ICA , ECA ؟
 * لا يخطئ ولا branches لا neck

I. Carotid system:

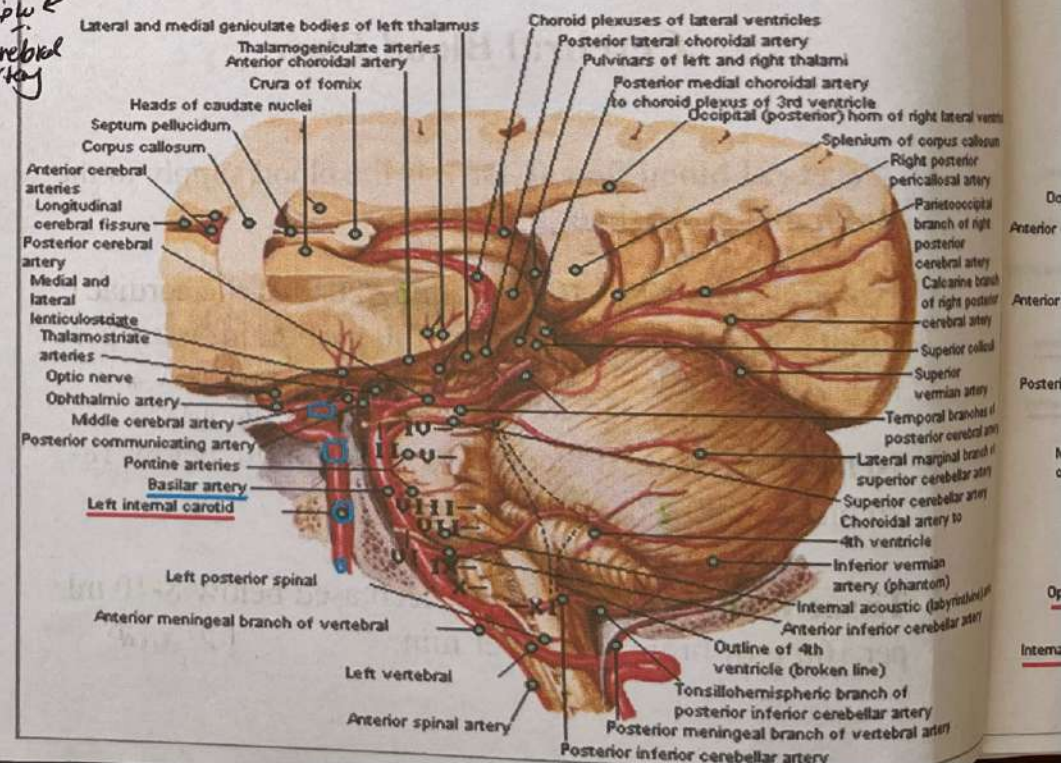
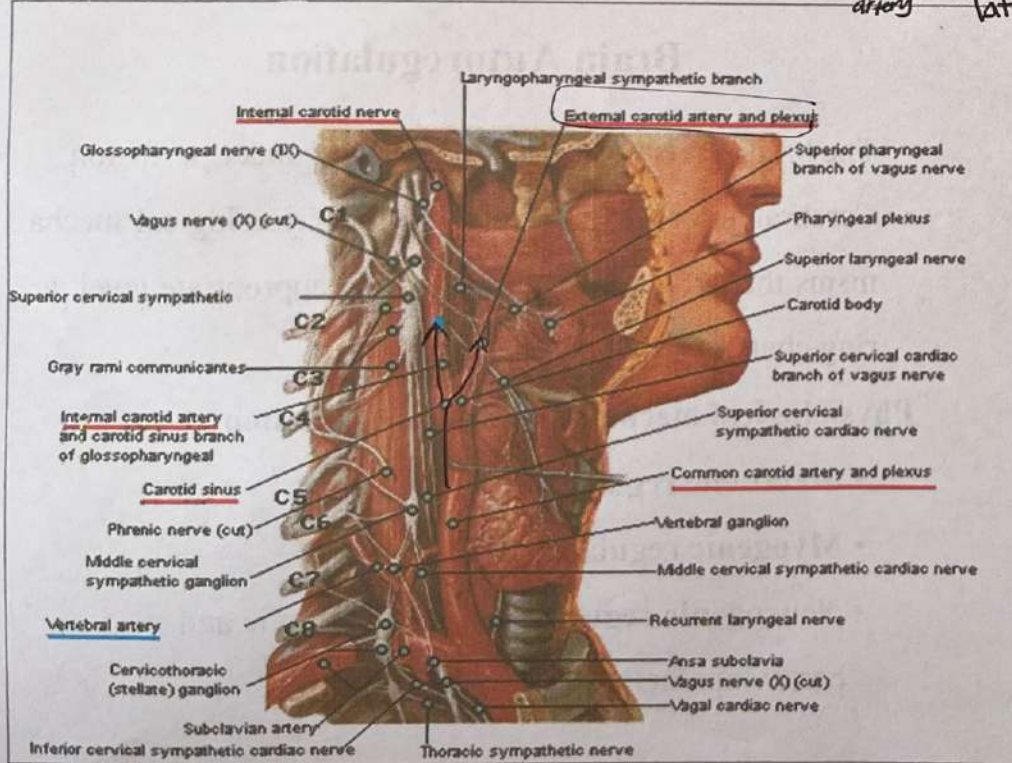
Common carotid artery → Internal carotid artery (ICA). Each ICA enters cranial cavity through carotid canal.

Branches of the internal carotid arteries:

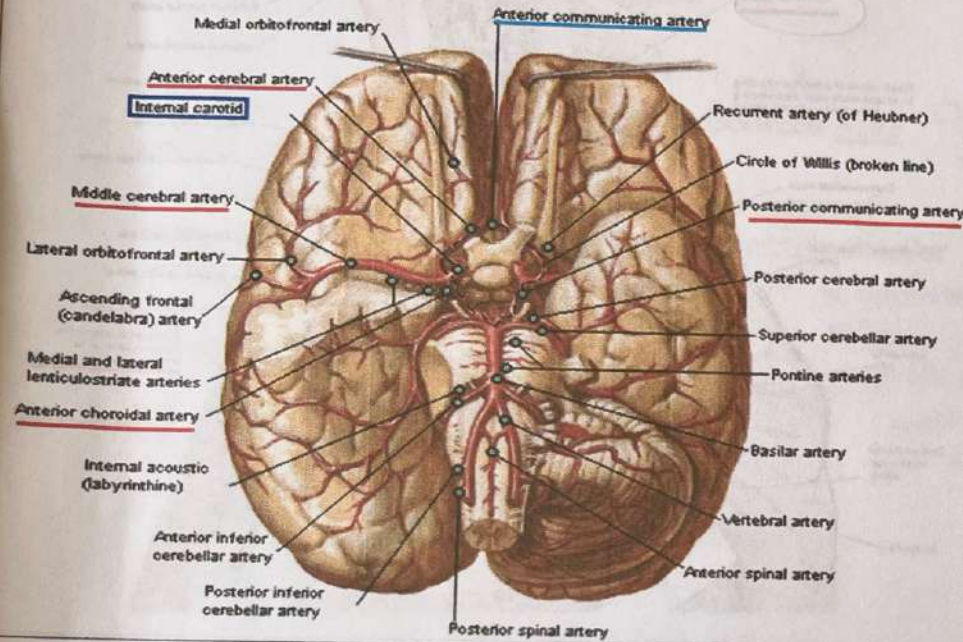
- 1st branch ← 1. Ophthalmic artery → Gives central retinal artery.
- 3rd " ← 2. Anterior choroidal artery (supply choroidal plexus).
- 2nd branch ← 3. Posterior communicating artery.
- Terminal branch ← 4. Middle cerebral artery.
- 4th ← 5. Anterior cerebral artery.

* The Terminal and largest branch is (middle cerebral artery) lat. branch
 وهذا يعني

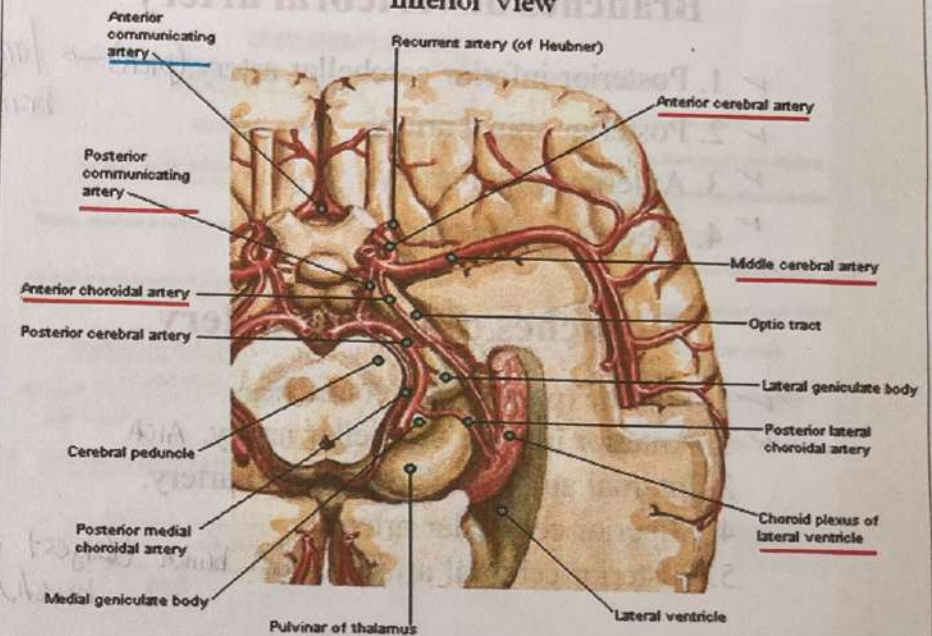
Post. lateral surface : superior, occipital area
 ant. Cerebral artery lat. area
 Post cerebral artery



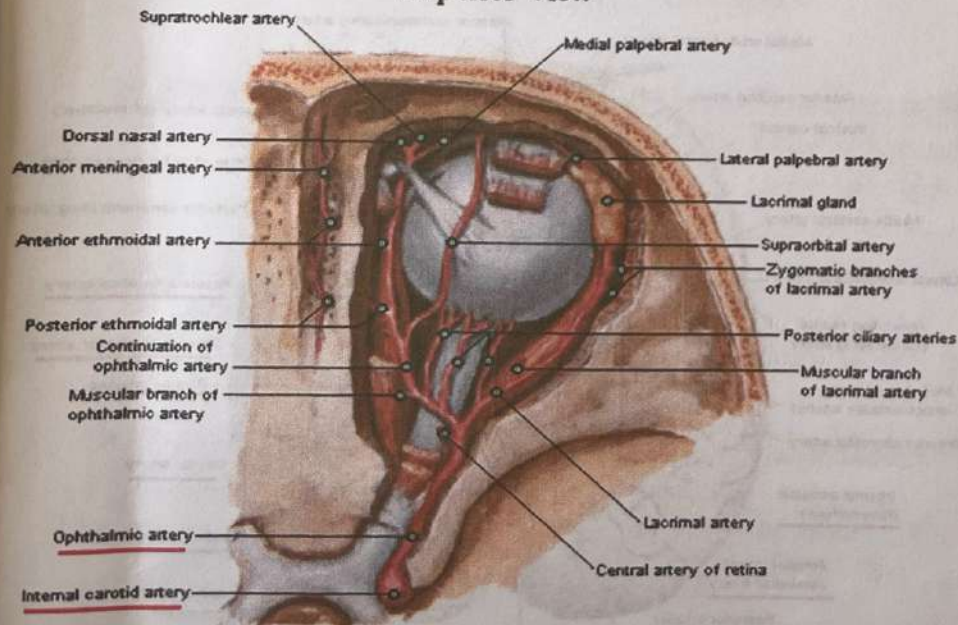
Arteries of Brain Inferior View



Arteries of Brain [Continued] Inferior View



Arteries and Veins of Orbit and Eyelids Superior View



II. Vertebrobasilar System:

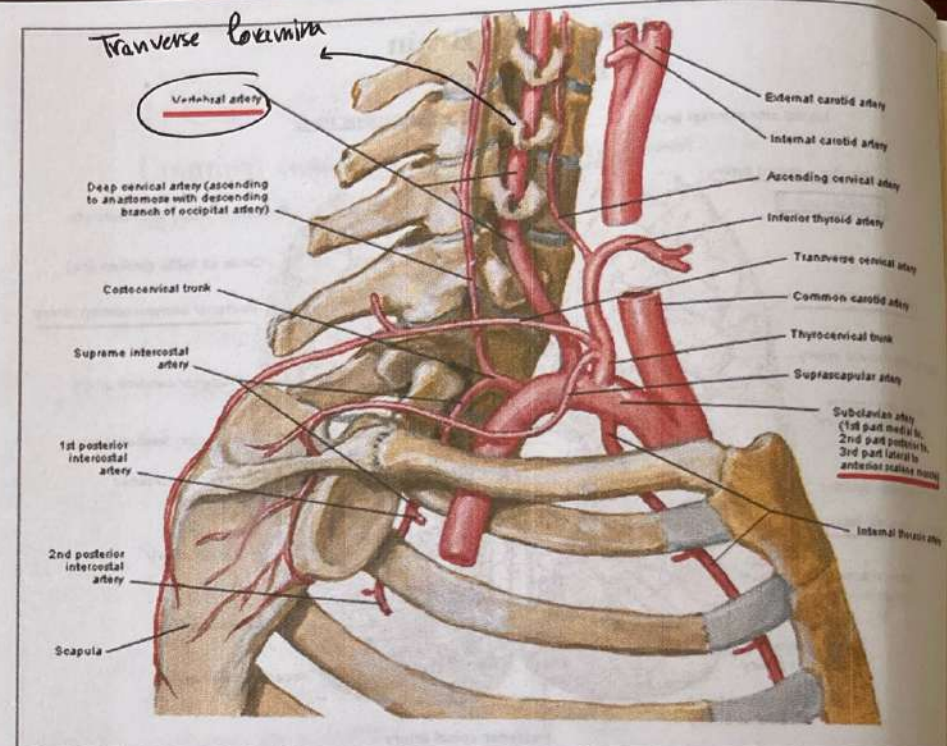
From the first part of subclavian artery → vertebral artery → then passes upwards through the transverse foramina of the upper 6 cervical vertebrae → foramen magnum → one midline single basilar artery.

Branches of vertebral artery

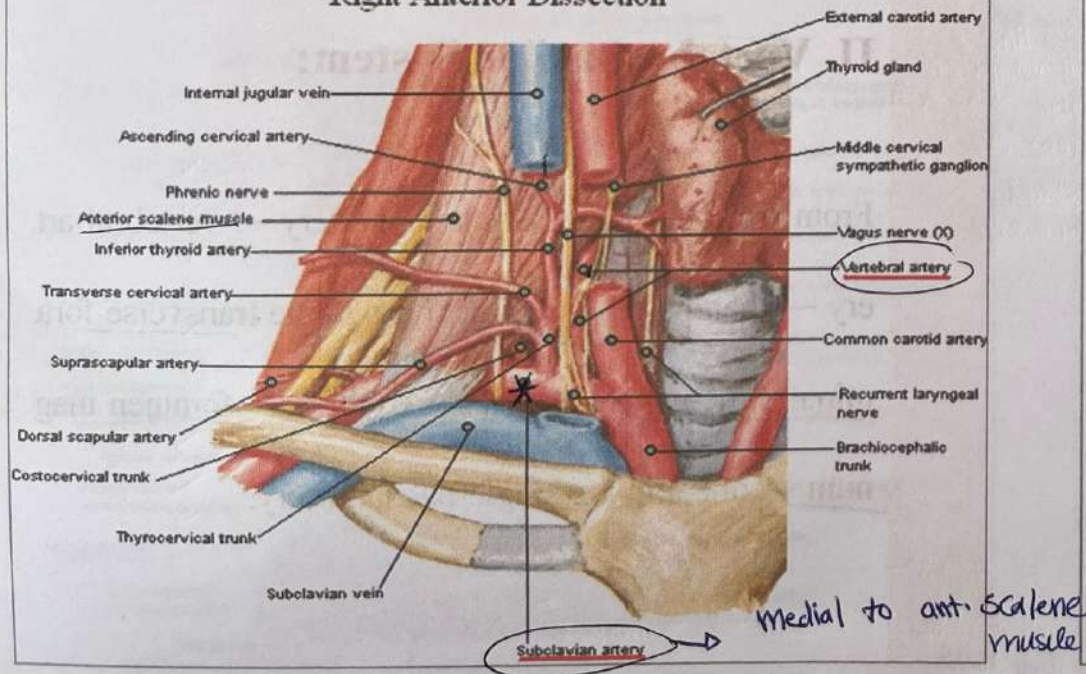
- ✓ 1. Posterior inferior cerebellar artery. (PICA) → largest branch
- ✓ 2. Posterior spinal artery.
- ✓ 3. Anterior spinal artery.
- ✓ 4. Medullary branches.

Branches of basilar artery

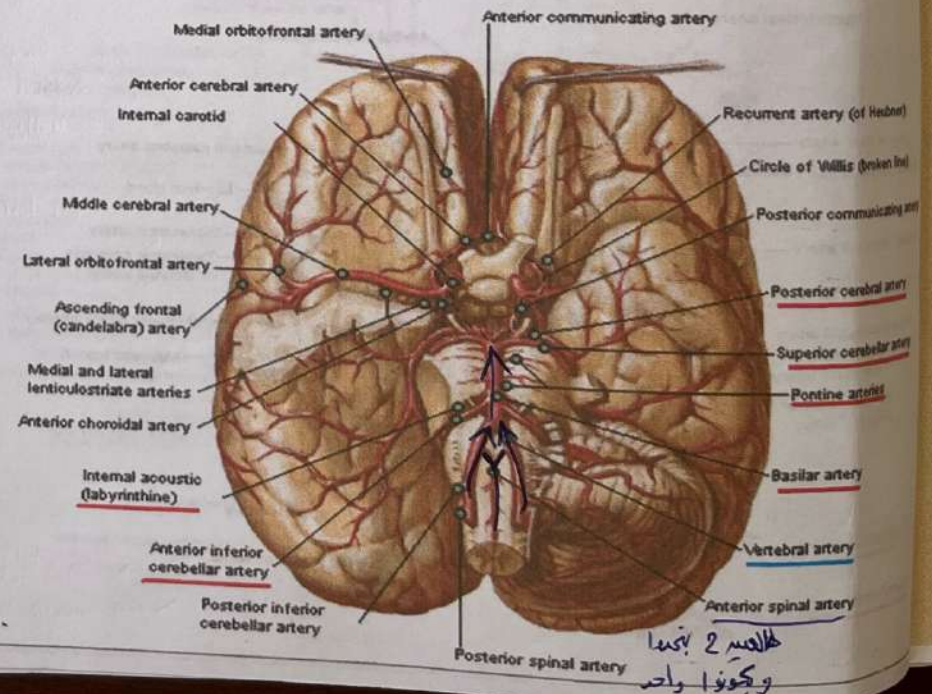
- ✓ 1. Pontine (paramedian) branches.
- ✓ 2. Anterior inferior cerebellar artery. AICA
- 3. Internal auditory (labyrinthine) artery.
- 4. Superior cerebellar artery.
- 5. Posterior cerebral artery → last branch (largest branch)



Subclavian Artery Right Anterior Dissection



Arteries of Brain Inferior View



Circle of Willis

Definition: it is an arterial anastomoses between **Nine** arteries supplying the brain.

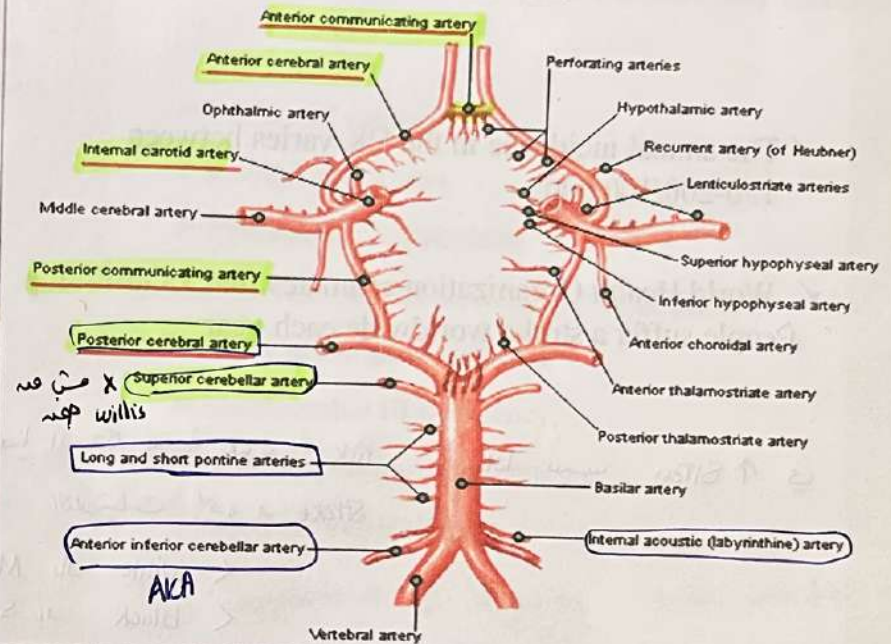
Function: Direct blood to other branches in cases of occlusion and connect carotid system with vertebrobasilar system.

Circle of Willis formation:

- Anterior communicating artery (One).
- Anterior cerebral arteries (Two).
- Internal carotid arteries (Two).
- Posterior communicating arteries (Two).
- Posterior cerebral arteries (Two).

* انضمام
v. basilar + carotid
عناقه لو واحد فيهم
سكن الثاني
ليكون

Circle of Willis - Vessels Dissected Out Inferior View



Cerebrovascular Disease

الجلطة الدماغية

- **Stroke "Brain Attack":** is sudden focal neurological deficit due to **vascular lesion** lasting **longer than 24 hours**.

أعراضها أقدم من 24 ساعة

- **Minor Stroke:** patient recover without significant deficit, usually **within a week "24 hours-7 days"**.

صغير لعملة في الكلام، وفقدت في اليد < 24 ساعة - الاسبوع

- **Lacunar infarction:** lacunes are **small (<1.5 cm)** area of infarction seen in CT, MRI or at autopsy.

بعض minor deficit بقولاه به مسيطر لاني نقل و ايده ورجله
زواله أو انه - يحس hand weakness

Stroke: Epidemiology

- ✓ **800,000** strokes occur each year in the US.
- ✓ **200,000** are **recurrent** strokes. → * يعني 1/25 من حالات ال Stroke recurrent
- ✓ One new case of stroke every **40 seconds** in the US.
- ✓ **The third** leading cause of death "175,000 die within one year- 25%". → 1/25 من حالات يتوفوا خلال السنة الاولى.
- ✓ One person dies from stroke every **4 minutes**.
- ✓ The leading cause of long-term disabilities, 15 to 30 % live with **permanent disability**.

✓ The annual incidence in the UK varies between 150-200/100 000.

✓ World Health Organization estimates that **15 million** people suffer a stroke worldwide each year.

← كما تقريبا 150 نسمة في سنة تتعرض risk ، حاليا بسبب Stress ↑ في شباب بالتدخين ، ينجو ب stroke
 * MS بال White <
 * Stroke بال black <

Stroke: Risk Factors "Nonmodifiable"

عوامل ما لا يمكن التحكم منها ولا تغييرها

- ❖ Age: risk doubles for every decade after age 55 years.
- ❖ Sex: Male > Female.
- ❖ Race: African/Black American > White American.
- ❖ Heredity.
- ❖ Family history of stroke/TIA

Stroke: Risk Factors

"Modifiable" تغييرها

- ✓ • HTN.
- ✓ • DM.
- ✓ • Cigarette Smoking.
- ✓ • Heart disease (valve disease, AF and others).
- ✓ • Dyslipidemia.
- ✓ • Obesity.
- ✓ • Carotid disease (carotid stenosis), atherosclerosis
- ✓ • Physical inactivity. قلة الرياضة
- ✓ • Hypercoagulability.
- ✓ • Drug abuse (e.g. cocaine use).
- ✓ • Heavy alcohol use.
- ✓ • Hormone replacement therapy.
- ✓ • Oral contraceptive. →

Coagulation التندد

* SAH :

سبب ال bleeding وال severe headache

Complication داء

(Vasoconstriction)

مع systemic داء ال SLE ، ال

Subarachnoid hemorrhage

Vessels Disease- Risk Factor of Stroke

Large vessels include both:

- The extracranial (common and internal carotids, vertebral)
- The intracranial arterial system (Circle of Willis and proximal branches)

Pathologies affecting large extracranial vessels include:

- ✓ ➢ Atherosclerosis
- ✓ ➢ Dissection
- ✓ ➢ Arteritis (Giant cell arteritis)
- ✓ ➢ Fibromuscular dysplasia

Pathologies affecting large intracranial vessels include:

- Atherosclerosis
- Dissection
- Arteritis/vasculitis
- ✓ ➢ Noninflammatory vasculopathy
- ✓ ➢ Vasoconstriction

High-Risk Cardiac Source for Embolic Stroke

- Atrial fibrillation.
- Rheumatic mitral or aortic valve disease.
- Bioprosthetic and mechanical heart valves.
- Atrial or ventricular thrombus.
- Recent myocardial infarction (within one month).
- Chronic myocardial infarction together with ejection fraction <28 percent.
- Symptomatic congestive heart failure with ejection fraction <30 percent.
- Dilated cardiomyopathy.
- Nonbacterial endocarditis as found in patients with systemic lupus, antiphospholipid syndrome, and cancer.
- Infective endocarditis.
- Left atrial myxoma.
- Coronary artery bypass graft (CABG) surgery →

* الخلية موكبية هجمات / مصلية
محتاجه warfarin
همام من احتاجه

قبل على CABG يلقى

اهل المريض يومتوا في حال هار stroke ملاب دعوة ، لانه امته الملية
عك لخص detachment , thrombus , fragment و قبل occlusion يار
distal cerebral arteries

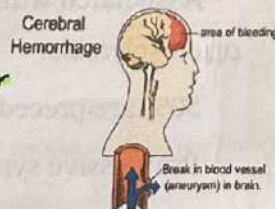
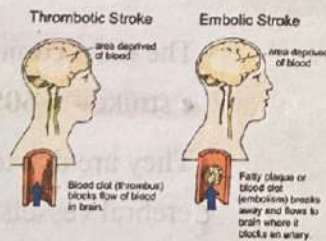
Classification of Stroke

❖ Ischemic Stroke: 85%

- Thrombotic.
- Embolic.
- Lacunar.
- Hemodynamic.

❖ Hemorrhagic Stroke: 15%

- Intracerebral and intracerebellar hemorrhage 10%.
- Subarachnoid hemorrhage 5%.

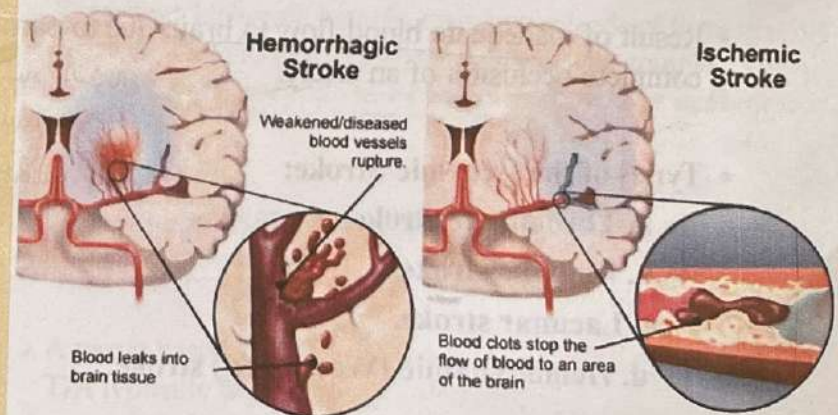


rupture artery عن نتاج

Blood Disorders- Risk Factor for Stroke

- Sickle cell anemia.
- Polycythemia vera.
- Essential thrombocytosis.
- Protein C or S deficiency. → ↑ coagulation
- Prothrombin gene mutation.
- Antithrombin III deficiency.
- Antiphospholipid syndrome.
- Hyperhomocysteinemia.

* عوامل هاء هتزداد Coagulation و Viscosity of blood ...



Cerebrovascular Disease

ischemic CVD = ischemic CVA
 ↳ accident

- **Carotid ischemic stroke- 80%.**
- **Vertebro-basilar ischemic stroke- 20%.**

3h (اليوم بجولوا كى 6 ساعات لحد)
 عولها لـ Viable tissue

لو حسنت الـ blood خلال
 perfusion

Ischemic Stroke

- Result of inadequate blood flow to brain due to partial or complete occlusion of an artery.

* كاما حبار انسداد للشريان
 embolus
 اذ حبار اtherosclerosis
 ناسنر

Types of the Ischemic Stroke:

- Thrombotic stroke.
- Embolic stroke.
- Lacunar stroke.
- Hemodynamic (Watershed) stroke.

Ischemic Penumbra

- **Border Zone:** reversible
 ↳ area that surrounds the ~~the~~

ischemic area in which there is
 dead tissue

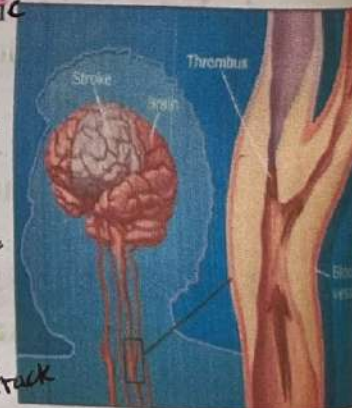
is reduced blood flow but which can be restored (3 hours)



منسوخا : لو اشتغلنا صبح حكة احوالها لـ Viable tissue سليم
 لكن لو حجت نزلت المنطقة بسوية يعني perfusion
 لـ dead tissue

a. Thrombotic Ischemic Stroke

- The **most common cause of ischemic stroke - > 60%.**
- They are due to occlusion of large Cerebral vessels.
- Associated with HTN, DM, and atherosclerosis.
- 50% are preceded by TIA. *Transient ischemic attack*
- Progressive symptoms during hours



b. Embolic Ischemic Stroke

- Second most common cause of ischemic stroke
- stroke > 25%.



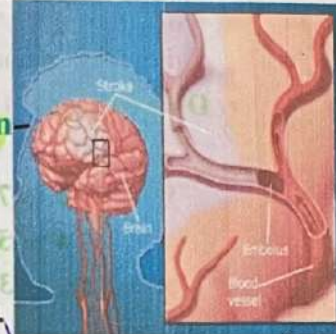
- Sudden, rapid occurrence of severe neurologic deficits.

Tendency to hemorrhagic transformation.

هذه يمكن ان يتحول الى نزف
hemorrhagic transformation = (hemorrhagic infarction) نزف

1. Cardioembolic stroke.

2. Arterioarterial embolic stroke.



جانبية من القلب
heart

جانبية مثلاً من Cerebral art. و art. بالباغ

D. Hemodynamic Ischemic Stroke

بالإسكيمية تستعملت
ischemic stroke

بمنزلة ضغط الدم و لا حركته في gentle reduction

- Hemodynamic or **Watershed** ischemic stroke.

هذا عند hypoperfusion

- They are due to **cerebral hypoperfusion** in the most distal arterial territories.

الجزء البعيد من الدماغ

compensation HIN

لنقل الدم الى هناك

موت الاعيان

- Can produce bilateral neurologic symptoms.

systemic hypoperfusion
في الـ Rt و الـ Lt
لهذا هذا يعني

واحد عنده

- These occur in situations of prolonged hypotension during:

استمرار الـ hypotension

- Severe dehydration, diarrhea

و الـ Rt و الـ Lt

- Operations under general anesthesia.

hypotension

- Aggressive management of pulmonary oedema or hypertensive crisis.

الضغط العالي و نوباته

- Cardiorespiratory arrest.

diuretic
لهذا هذا يعني

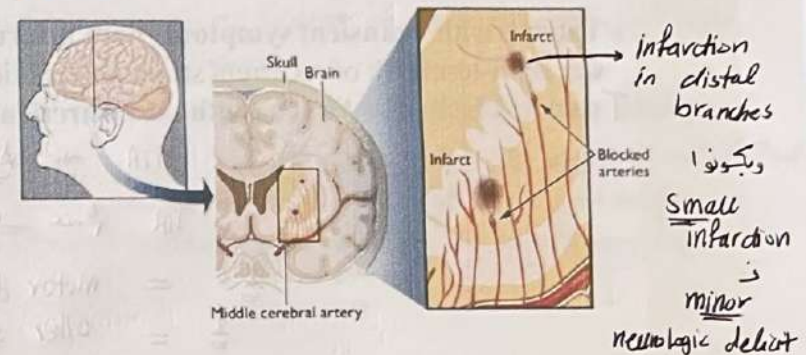
لا الـ hypotension

في وقت قلبه علينا اننا نأخذ
بذلك يكون ذلك حاله
ischemic

المزمن

c. Lacunar Ischemic Stroke

- Third cause of ischemic stroke - > 10%.
- Occlusion of deep penetrating cerebral arteries due to HTN, DM and vasculitis.
- Small lacune with minor neurologic deficits: **motor and sensory loss.**



Transient Ischemic Attack

- Transient Ischemic Attack:** transient episode of focal neurologic deficit due to vascular lesion lasting (with complete recovery) from a **few seconds to 24 hours** and **without acute infarction.**

لا الـ infarction خلال 24 h

No infarction

- Tissue-based definition of TIA:** absence of ischemic infarction by neuroimaging.

- A tissue-based TIA definition noted that clinical symptoms of TIA typically last **less than one hour.**

* اكثر من 1 ساعة قد سيترافق
حتى 24 h

- * Neuro. deficit symptoms > 24h → stroke
- * " " " " < 24h without infarction → TIA
- * " " " " with " → C. infarction with transient signs

➤ **Transient symptoms with infarction or "cerebral infarction with transient signs":** transient neurological signs (<24 hours in duration) can be associated with ischemic infarction.

➤ Patients with **Transient symptoms with infarction** have a higher ~~for~~ short-term risk of recurrent stroke than patients who have **Transient Ischemic Attack (without infarction)**.

Transient with infarction TIA 6 Se يكون عندهم خلال يومين

Ischemic stroke < TIA عندهم

2 = motor deficit : إذا تغير
1 = other symptom

Clinical manifestation of stroke



Sudden onset of :

- ✓ Weakness or paralysis of the face, arm, or leg on one side of the body (Unilateral: monoplegia or hemiplegia).
- ✓ Unilateral numbness or loss of sensation.
- ✓ Discoordination "ataxia".
- ✓ Speech difficulty: aphasia or dysarthria.
- ✓ Acute unilateral loss of vision. , acute mental status change , confusion
- ✓ Dizziness, sudden falling, especially with any of the other signs.
- ✓ Acute mental status changes, confusion, coma.
- ✓ Seizure.



3rd Nerve palsy Complete ptosis *

Partial ptosis

Hemihypoesthesia

due to damage descending spinal nucleus

interruption sympathetic fibers

Trigeminal nerve

ventral lateral Spinothalamic tract

The ABCD2 Score

Age Bp

- Age: ≥60 years = 1 point.
- Blood pressure: Sys. ≥140 mmHg or Dias. ≥90 mmHg = 1 point.
- Clinical features: unilateral weakness = 2 points; isolated speech disturbance = 1 point; other = 0 points.
- Duration of TIA symptoms: ≥60 min = 2 points; 10 to 59 min = 1 point; <10 minutes = 0 points).
- DM: present = 1 point.

Stroke 8 من خلال يومين يدخلوا بـ

Score 6 to 7: High two-day stroke risk (8%).

Score 4 to 5: Moderate two-day stroke risk (4%).

Score 0 to 3: Low two-day stroke risk (1%).

① Transient dysarthria 6 160/100 ② 4 6 ③ 4 6 ④ 4 6 ⑤ 4 6 ⑥ 4 6 ⑦ 4 6 ⑧ 4 6 ⑨ 4 6 ⑩ 4 6 ⑪ 4 6 ⑫ 4 6 ⑬ 4 6 ⑭ 4 6 ⑮ 4 6 ⑯ 4 6 ⑰ 4 6 ⑱ 4 6 ⑲ 4 6 ⑳ 4 6 ㉑ 4 6 ㉒ 4 6 ㉓ 4 6 ㉔ 4 6 ㉕ 4 6 ㉖ 4 6 ㉗ 4 6 ㉘ 4 6 ㉙ 4 6 ㉚ 4 6 ㉛ 4 6 ㉜ 4 6 ㉝ 4 6 ㉞ 4 6 ㉟ 4 6 ㊱ 4 6 ㊲ 4 6 ㊳ 4 6 ㊴ 4 6 ㊵ 4 6 ㊶ 4 6 ㊷ 4 6 ㊸ 4 6 ㊹ 4 6 ㊺ 4 6 ㊻ 4 6 ㊼ 4 6 ㊽ 4 6 ㊾ 4 6 ㊿ 4 6

moderate ← (point 4) بيتو

Brainstem Infarction

• **Hemimedullary syndrome:** lateral and medial medullary syndrome "Occlusion of proximal part of vertebral artery".

• **Lateral medullary syndrome** also called posterior inferior cerebellar artery (PICA) thrombosis or Wallenberg's syndrome

ipsilateral facial numbness, nystagmus, cerebellar ataxia,

Horner's syndrome, dysphagia, dysarthria and contralateral

damage ambiguous nucleus

due to lesion in spinal

Trigeminal nerve

ventral lateral Spinothalamic tract

Brainstem Infarction

- **Medial medullary syndrome** "**Dejerine syndrome**" "occlusion" ^{origin ant. spinal art; vertebral →}

of ASA: also known as inferior alternating syndrome,

hypoglossal alternating hemiplegia: This results in the infarction of medial part of the medulla oblongata characterized by:

- **Tongue deviation** to the side of the lesion. → due to damage hypoglossal nucleus ipsilat.
- **Hemiplegia** on the **contralateral** side of the lesion. → due to damage cortico-spinal tract above crossing
- **Loss of deep sensation** on the **contralateral** side of the lesion. → fine touch due to damage medial lemniscus above gracile and cuneate nuclei

MRI CT * التمييز أفضل مع MRI
CT " " stroke بل MRI *

Stroke: Investigation

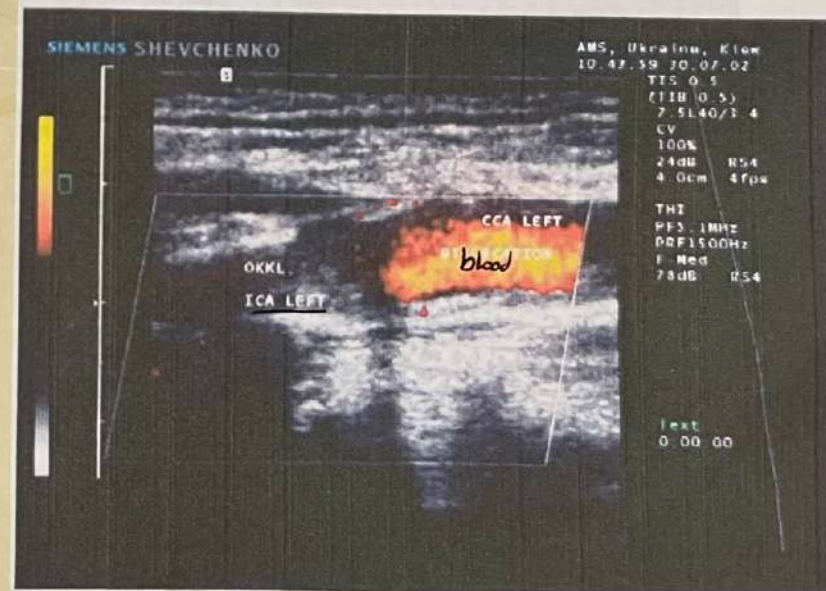
1. Blood evaluation: CBC, ESR
2. Risk factor detection: Cholesterol, Triglyceride, glucose level, coagulate state
3. Cardiac evaluation: X-ray, ECG, Echocardiography in suspected cases, to exclude embolism.
4. Brain imaging: CT scan & MRI → أفضل وأوسع
5. Blood vessel visualization: Duplex scan (combine ultrasound imaging with Doppler evaluation), MRA, Cerebral angiography.

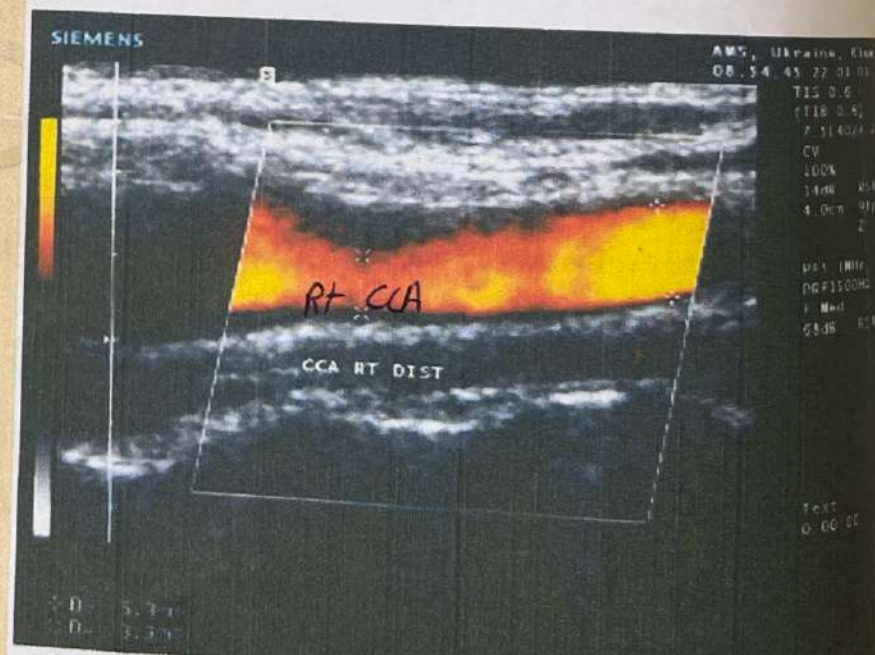
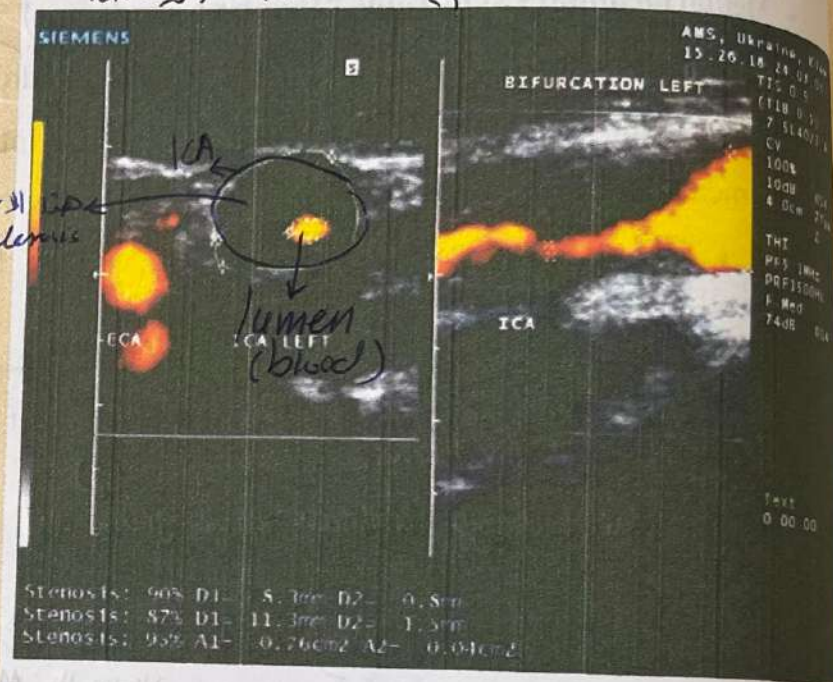
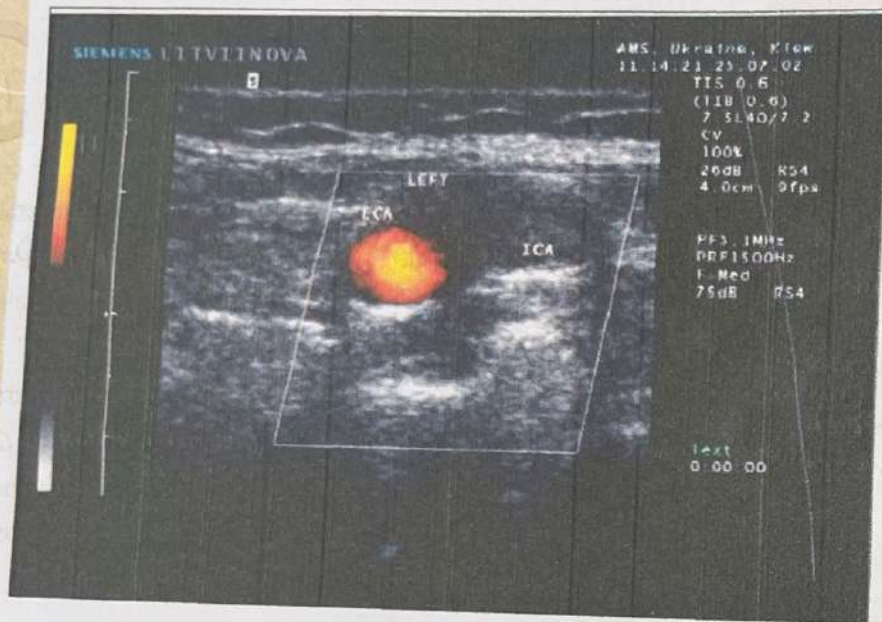
stenosis → إذا في
تشوهات
malformation

Brainstem Infarction

- **Coma**: follows damage of the brain reticular activating system } هيبس
عامة Coma
- **The locked-in syndrome**: basilar artery occlusion.
- **Millard-Gubler Syndrome** "**Ventral pontine syndrome**" or **crossed hemiplegia**: ipsilateral facial nerve palsy "LMNL" and **contralateral hemiplegia** due to damage motor nucleus of facial N in Pons
- **Foville syndrome**: ipsilateral VI nerve palsy and **facial nerve palsy** "LMNL" and contralateral hemiplegia.
- **Weber syndrome**: ipsilateral third cranial nerve palsy and contralateral hemiplegia) → damage oculomotor nucleus in midbrain + corticospinal tract
- **Benedict syndrome**: ipsilateral oculomotor nerve palsy with hemiataxia and contralateral hemiparesis with involuntary movement "chorea, tremor"

Blood vessel visualization: Duplex scan





* management of cerebral infarction :-

- General medical measures → 4B → Bed, Bladder, Bowel, Breath
- O₂ by mask
- Check BP and pulse
- Brain image
- Thrombolysis therapy → immediate Brain CT is essential (Total dose of IV tissue plasminogen 0.9 mg/kg)
- mechanical thrombectomy
 ↳ decreased disability and ↑ functional independence during the 1st 90 day
 max. 90 mg

(*) Contraindication لـ thrombolysis أسفل aspirin 325 mg

(*) Contraindication لـ ischemic stroke أسفل 6 أسابيع

plasminogen أسفل

* antiplatelet (aspirin, clopidogrel, aggrenox 200/25 mg)
 200 mg Dipyridamole → 25 mg aspirin

* surgical ⇒ internal carotid endarterectomy,
 • stent for symptomatic patient with > 70% stenosis

CT manifestation of ischemic infarction

✓ CT manifestation of ischemic infarction is a zone of slightly

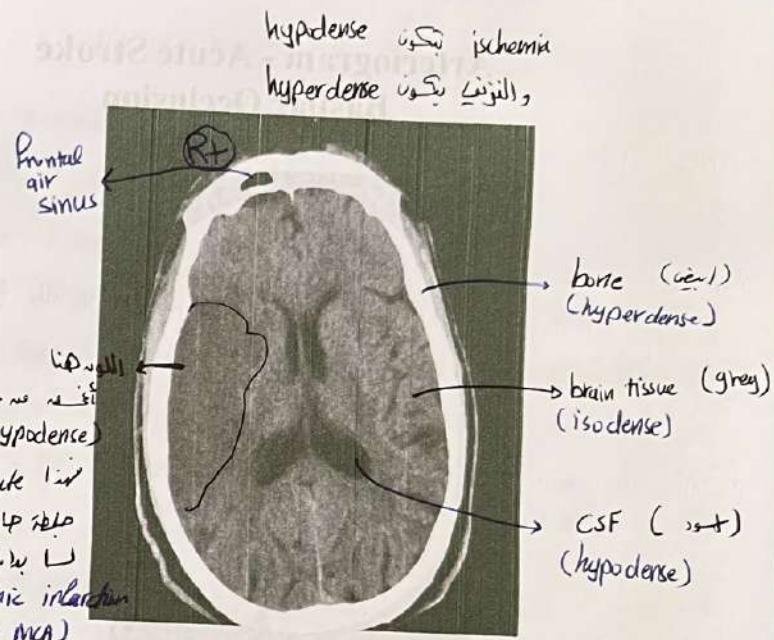
reduced density (hypodense), beginning on the second day
 بعد يومين من السكتة الدماغية
 and with a maximum around the fifth day.

➤ The final stage of an infarction, the encephalomalacic cyst.

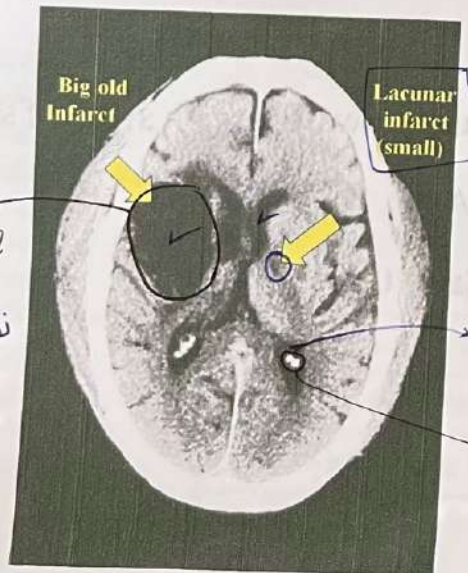
✓ سكتة دماغية stroke فسيكون هناك منطقة hypodense
 في CT

✓ لو صغرنا طول سمات حالات ischemic infarction ← 1.20
 فيكونوا بيظهر

في حالات
 لكن 1.80 تبين بعد مرور 24 ساعة - 48 h



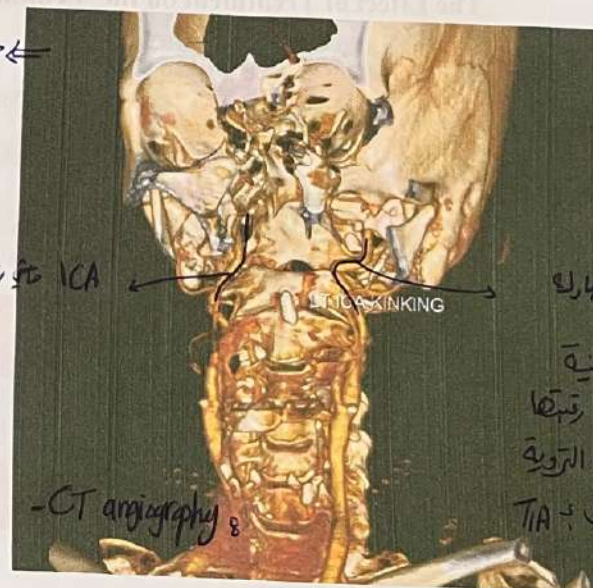
* كلما زاد اللون سواد كلما قلت الكثافة



density
 نقص أو
 كثافة
 وبيوت

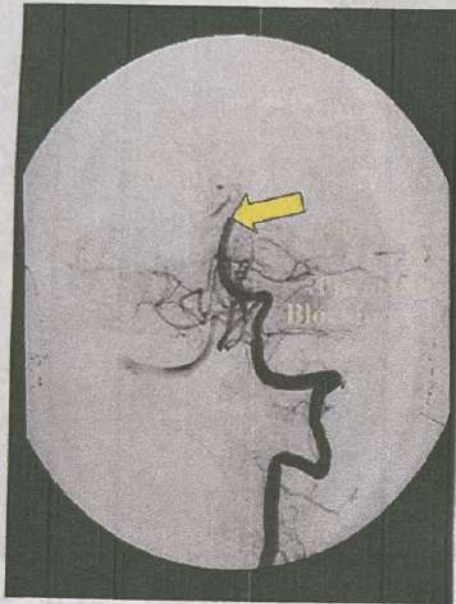
post horn of lateral
 Ventricle
 choroid plexus
 classification

← حالة كل شوية جاية
 TIA

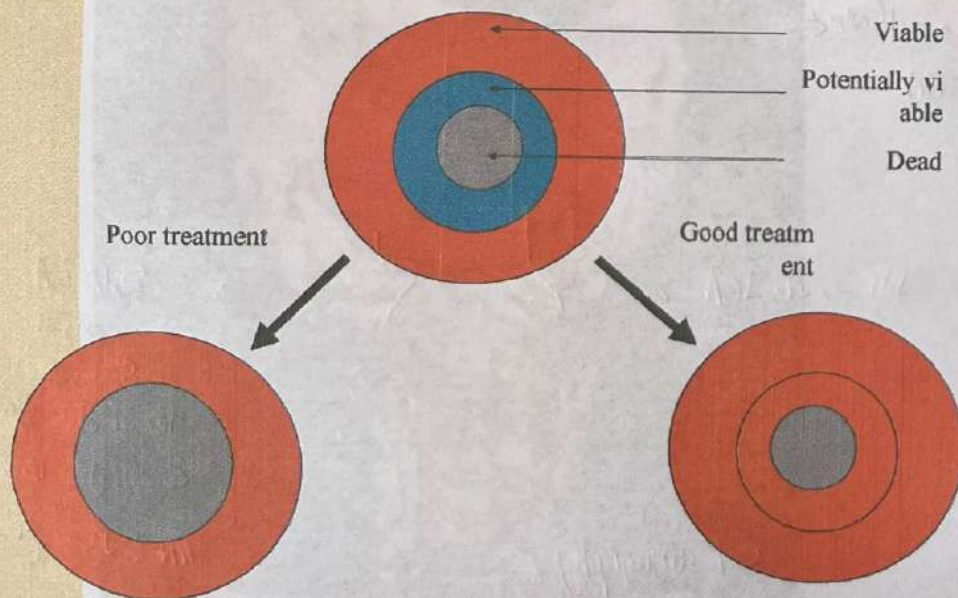


ICA
 bifurcation
 CT angiography

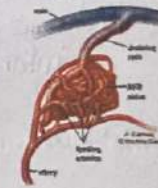
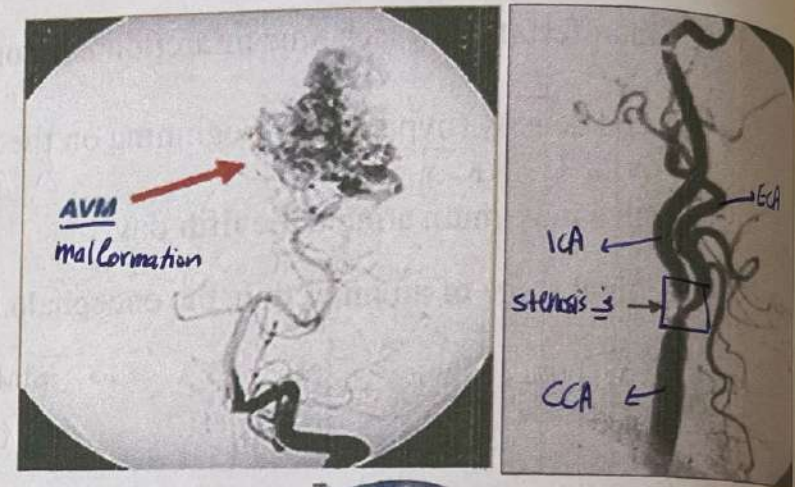
Arteriogram - Acute Stroke Basilar Occlusion



The Effect of Treatment on the Penumbra



Cerebral Angiography



Pre-Hospital

- ✓ ➤ Public awareness on signs of stroke.
- ✓ ➤ FAST.
- ✓ ➤ Call 101.

FAST

ACT F.A.S.T!



FACE

• Ask the person to smile. →

asymmetry
Face



ARM

• Ask the person to raise both arms. →

drop



SPEECH

• Ask the person to speak a simple sentence.

لفظ بالكلية



TIME

• To call 101.

National Institutes of Health Stroke Scale "NIHSS"

The NIHSS is composed of 11 items:

1. Level of consciousness.
2. Horizontal eye movement.
3. Visual field test.
4. Facial palsy.
5. Motor arm.
6. Motor leg.
7. Limb Ataxia.
8. Sensory.
9. Language.
10. Speech.
11. Inattention.

Score	Stroke Severity
0	No Stroke Symptoms TIA
1-4	Minor Stroke
5-15	Moderate Stroke
16-20	Moderate to Severe Stroke
21-42	Severe Stroke

Acute Stroke Presents to ED

➤ Ensure medical stability:

• **ABC's** (airway, breathing, circulation).

• **Care of the unconscious patient (4Bs):** "Bed, Bladder, Bowel and Breath"
لو مشكله بالنسبة
بترتيب O2 Catheter

➤ **Rapid assessment:** National Institutes of Health Stroke Scale (NIHSS).

➤ **CBC, Serum glucose, KFT.** hypoglycemia

➤ **ECG.**

➤ **Non-contrast brain CT.**

لأنه الحساسية لوها
subarachnoid Hemorrhage masking

Inpatient work-up

➤ Lipid profile.

➤ HbA1c.

➤ ESR, CRP.

➤ Blood pressure monitoring.

➤ Brain MRI if available.

➤ Echocardiography.

➤ Vascular imaging.

Treatment of Ischemic Stroke

- **Thrombolysis therapy (3-4.5 hour time window)**: immediate brain CT is essential. Total dose of intravenous tissue plasminogen 0.9 mg/kg, maximum 90 mg (See contraindication).
- **Mechanical thrombectomy**: significantly decreased disability and increased functional independence during the first 90 days.
- If present contraindication for thrombolysis give aspirin 325 mg/day.
- Anticoagulant if needed.
- Statins.

Stroke Prevention



- **Appropriate lifestyle modification** (smoking, exercise, diet etc).
- **Management of hypertension.**
- **Glucose control.**
- **Management of dyslipidemia**: Statins.
- **Small vessels disease (lacunar)**: single antiplatelet Aspirin (80-100) or clopidogrel (75 mg) daily.
- **Proximal carotid stenosis > 70%**: carotid revascularization.
- **Intracranial stenosis, aortic atheroma, carotid artery stent**: dual antiplatelet Aspirin (80-100) and clopidogrel (75 mg) daily for 90 days.
- **Atrial fibrillation**: anticoagulants (Warfarin, Eliquis or Xarelto).

نکه لو Valve replacement یا ختمه به Warfarin

Blood pressure care:

← **In hypotension**, raise the BP smoothly with vasopressors or fluids. بنوع الضغط بـ NS أو أدوية

↪ **In hypertension**, gentle reduction of BP if above 220/120 mmHg (<185/110 mmHg in patient with thrombolysis therapy). إذا ضغط > 220/120 ما نخفض هذا

Compensatory - For patients with ischemic stroke who are not treated with thrombolytic therapy, most guidelines recommend that blood pressure **not** be treated acutely if the BP below 220/120 mmHg.

* إنزل الضغط في حال دينا نظير thrombolysis to prevent intracranial bleeding
- Gentle reduction of BP in patients with active ischemic coronary disease, heart failure, aortic dissection, hypertensive encephalopathy, acute renal failure, or pre-eclampsia/eclampsia, retinal detachment
له هاي الحالات ننصح بكون الضغط عالي gently

Case # 1

- 55 years old man
- HTN, smoker 20 cig/day, dyslipidemia. ابي ديه 7 سنوات
- 6 hours before coming to ED with sudden loss of strength and sensitivity of left hemibody. The day before he experienced a similar episode resolving spontaneously in minutes. قبل يوم كان عنده 778
- **Physical examination**: conscious, disorientated, left side hemiparesis+hemi-hypoesthesia predominantly facio-brachial, and left side homonymous hemianopia
- BP: 180/95 mmHg, HR: 80/min, T: 37°C, SaO₂: 90%
- ECG: sinus rhythm no signs of ischemia
- Lab blood test: normal
- Chest X ray: normal

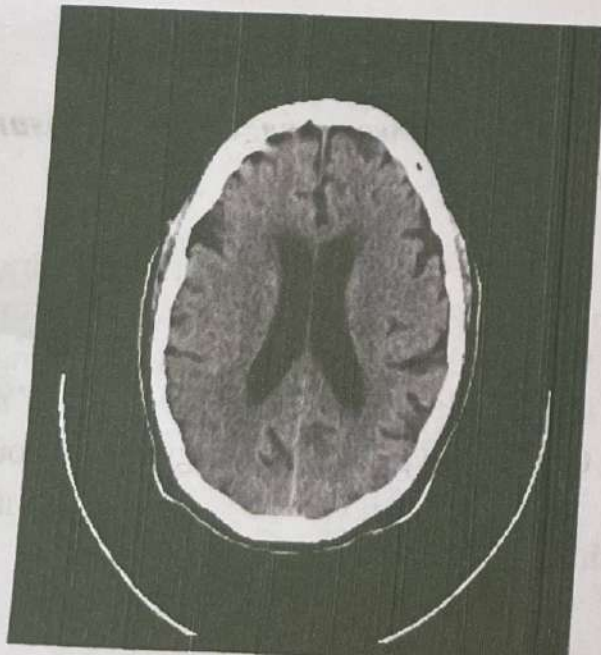
Case # 1

→ What should be the next step?

- Give immediately 325 mg of aspirin
- Give anticoagulant-dose of iv sodium-heparin
- Treat with iv tPA
- Call ICU for immediate admission and orotracheal intubation
- Perform an urgent cranial CT

لنمى نوع ال stroke

Case # 1



→ no acute changes

* Normal CT
doesn't exclude
I. Stroke in
initial hours
لا يبيانه stroke
بعد 24-48 h
لكه لو زلزلنا
فقدنا حياه

Case # 1

→ What should be the next step?

- Give immediately 325 mg of aspirin
- Give anticoagulant-dose of iv sodium-heparin
- Treat with iv tPA
- Call ICU for immediate admission and orotracheal intubation
- Perform an urgent cranial CT

لنمى نوع stroke

Case # 1

→ Which is the best therapeutic option for our patient?

- Antiplatelet therapy with 325 mg aspirin
- Anticoagulation dosing heparin
- Thrombolysis with iv tPA
- Aspirin and clopidogrel combination
- Mechanical clot extraction

Case # 1

→ Which is the best therapeutic option for our patient?

- a). Antiplatelet therapy with 325 mg aspirin
- b). Anticoagulation dosing heparin
- c). Thrombolysis with iv rt-PA
- d). Aspirin and clopidogrel combination
- e). Mechanical clot extraction

Case # 1

→ How should we manage blood pressure in our patient?

- a). Not use antihypertensive drugs because it is better to keep high BP values in that kind of patients.
- b). Give antihypertensive drugs sublingually to obtain an important and maintained decrease of BP values.
- c). Give antihypertensive drugs intravenously
- d). In the acute phase of a stroke we should target BP values below 140/60 mmHg

Sublingual
نوع

Case # 1

- 2 h after the arrival to the ED the nurse calls us because the patient presents BP values of 230/110 mmHg

لے قولنا لو فہمنا
تزلزلنا
220/110 >
230/110
ہنزل

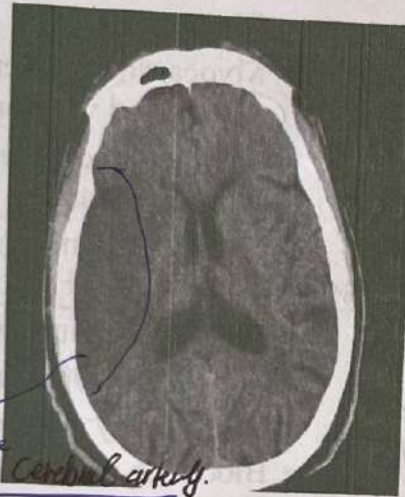
Case # 1

→ How should we manage blood pressure in our patient?

- a). We should not use antihypertensive drugs because it is better to keep high BP values in that kind of patients.
- b). We give antihypertensive drugs sublingually to obtain an important and maintained decrease of BP values.
- c). Give antihypertensive drugs intravenously
- d). In the acute phase of a stroke we should target BP values below 140/60 mmHg

Case # 1

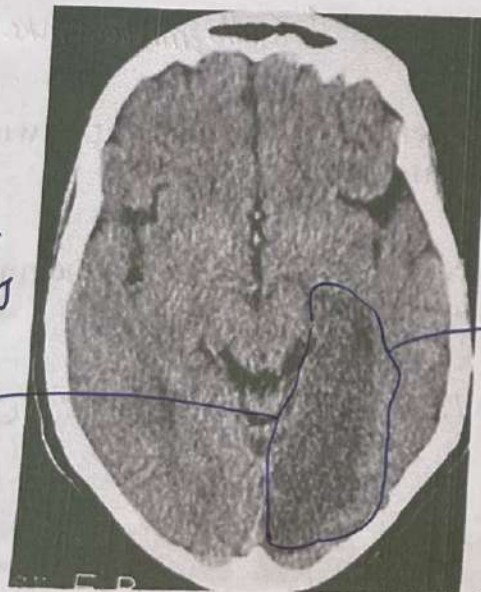
- Cranial CT performed 4 days later
- Carotid Ultrasounds: 80% stenosis in Rt ICA.
- Treated with angioplasty + stent
- Discharged 14 days later with mild left arm paresis



acute ischemic stroke in Rt middle cerebral artery.

area of upper limb, lat. surface of cerebral hemisphere

Case # 2



acute ischemic infarction in Lt. PCA

Lt. posterior cerebral artery

hypodense

Lt. occipital lobe

acute

لأنه لو همار لونها زرق = لونه CSF يعني سورا اوده

يعني old و chronic

Case # 2

- 77 years old woman
- No significant previous medical history. No previous medication
- A week before: unstable gait + diplopia episode that lasted 10 mins.
- Physical examination: right homonymous hemianopia, arrhythmia, diastolic murmur on mitral focus.
- BP: 160/70 mmHg, HR: 80/min, T: 36.7°C, SaO₂: 95%
- ECG: AF 80/min
- Chest X ray: normal
- Blood lab test: normal

قبل اسبوع لده عندهما TIA

stenosis in mitral valve

يعني بطل بيوت في انفسه
المية من القلب 14، والرفا
الغيسه من زاحيه 14

Case # 2

→ In that case we should.

- Refer the patient to the Neurology out-patient clinic for further studies.
- Give aspirin and discharge the patient back home since the symptoms have been transitory. stenosis mitral AF لانه عنده
- The patient should be admitted and anticoagulant treatment should be started immediately.
- Our patient is too old, anticoagulation is contraindicated.

Case # 2

→ In that case we should.

- Refer the patient to the Neurology out-patient clinic for further studies.
- Give aspirin and discharge the patient back home since the symptoms have been transitory.
- The patient should be admitted and anticoagulant treatment should be started immediately.
- Our patient is too old, anticoagulation is contraindicated.

شك بالجلطة في
مخروطية بالوريد

يكون عند
مخروطية
middle
cerebral
artery

Case # 3

- 75 years old man
- Myocardial infarction 15 years ago, chronic nonvalvular AF treated with oral anticoagulants.
- Found on the ground with right hemiparesis and difficulty to talk.
- Physical examination: good LOC, global aphasia, right hemiparesis (Facio-brachial type).
- BP: 170/70 mmHg, HR: 90/min, T: 37°C, SaO₂: 93%
- ECG: AF at 90/min
- Chest X-ray: no significant changes
- Blood lab tests: Biochem.- CK: 1200mg/dl, Hemogramme- normal, Coagulation- INR: 1,4

Case # 3

occlusion in
IF MCA

hyperdense



Case # 3

Cardioembolic stroke

→ 12 h later the patient presents a worsening in his clinical state:

Depressed LOC, vomiting, heavy hemiplegia, oculocephalic deviation of head to left.

- BP: 220/130mm Hg, HR: 95, T: 37,6°C, SaO₂: 93%

Case # 3

→ How should we act in that case?

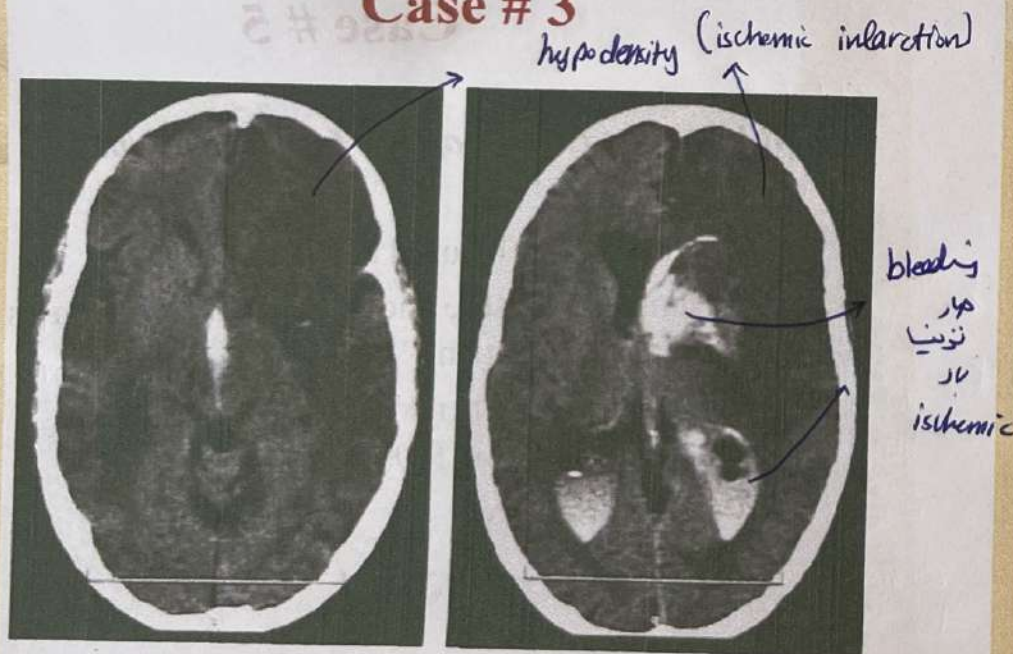
- a). Anticoagulate straight ahead because it's clear our patient suffered a new embolic stroke.
- b). Increase antiplatelet drug dose
- c). Call to ICU
- d). Repeat cranial CT

Case # 3

→ How should we act in that case?

- a). Anticoagulate straight ahead because it's clear our patient suffered a new embolic stroke.
- b). Increase antiplatelet drug dose
- c). Call to ICU
- ✓ d). Repeat cranial CT

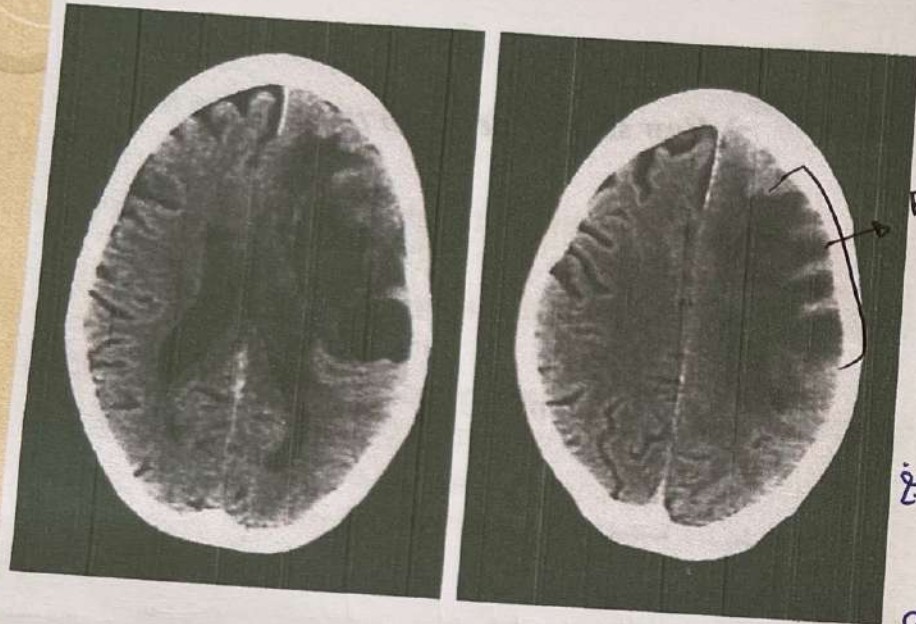
Case # 3



Case # 4

- 62 years old woman
 - No previous medical history. No medication
 - 2 weeks Progressive difficulty for saying the names of objects, in the last 3 days weakness in her right hand.
 - Physical examination: predominantly motor aphasia, right arm paresis, increased DTR
 - BP: 120/60 mmHg, HR: 80/min, T: 36,5°C, SaO₂: 96%
 - ECG: sinus rhythm
 - Chest X-ray: normal
 - Blood test: normal
- ✓ risk factor
✓ الارتفاع في ضغط الدم
✓ السكر في الدم

Case # 4



Finger like
edema

Tumor

هناك

Contrast

الذي

الورم

هو

ischemic

والشرية صغر
منه عند كل إصابة

Case # 4



هناك حيز كبير في
المنطقة

يتميز

Case # 5

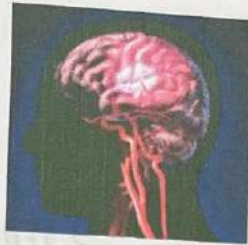
مشرحة #

- 24-year-old woman
- For 24 hours was feeling numbness of her left arm and left leg + poor balance, worsened in hours
- 6 or 7 months ago she had similar symptoms, resolved in a few days
- Two years ago she had an episode of blurred vision that resolved in about 2 weeks.

Case # 5

What is the correct option for this patient?

- IV tPA should be used in that case
- A lumbar puncture and brain MRI will help us to diagnose the patient
- We should treat her with high doses of metilprednisolone (1000mg) during 5 days
- b and c are correct



Lecture: 3 Hemorrhagic Cerebrovascular Disease

Dr. Eyad M. Hussein

MD, Ph.D of Neurology
Consultant in Neurology Department,
Nasser Hospital,
Assistant Professor,
Faculty of Medicine, Islamic University
Faculty of Dentistry, University of Palestine

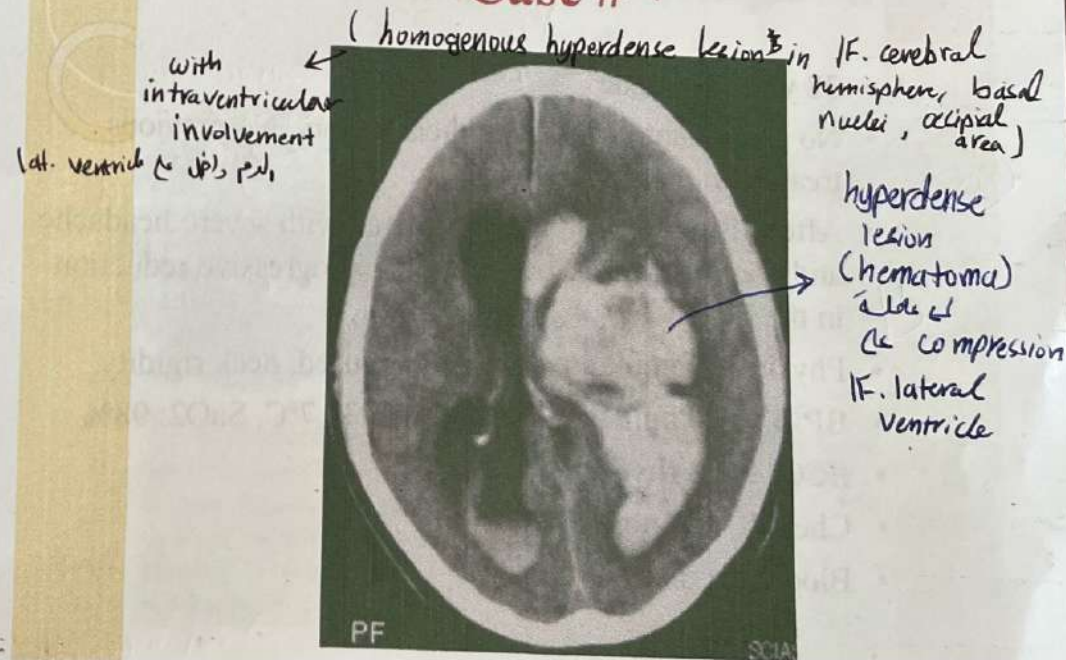
Case # 1

- 80 years old woman
- Mitral stenosis, chronic AF treated with warfarin
- Comes to ED with vomiting + headache followed by right hemiplegia and speech disturbances.
- Physical examination: stupor, global aphasia, right hemiplegia (Facio-brachial type).
- BP: 190/120mmHg, HR: 90/min, T: 39°C, SaO₂: 89%
- ECG: AF at 90/min
- Chest X-ray: normal
- Lab blood test: Biochem: normal, 17,000 leucocytes, Coagulation: INR: 5.2

لعين في زيادة كمية الوارفارين



Case # 1



Case # ١

→ What is the correct attitude in that case?:

- a). Consult the Neurosurgeon
- b). Withdraw and revert the anticoagulant therapy. *نوقف الوارفارين*
- c). Treat HBP with iv labetalol *نعالج الضغط بالحقن*
- d). Take some blood samples for culture and begin empiric antibiotic treatment
- e). All those measures are necessary

Case # ٢

- 38 years old male
- No significant previous medical history. No previous treatment.
- After lifting a heavy box, he started with severe headache and vomiting, in the next minutes: progressive reduction in the LOC. *level of consciousness*.
- Physical examination: stupor, confused, neck rigidity.
- BP: 170/80 mmHg, HR: 70min, T:37,7°C, SaO2: 98%
- ECG: sinus rhythm
- Chest X-ray: normal
- Blood test: normal

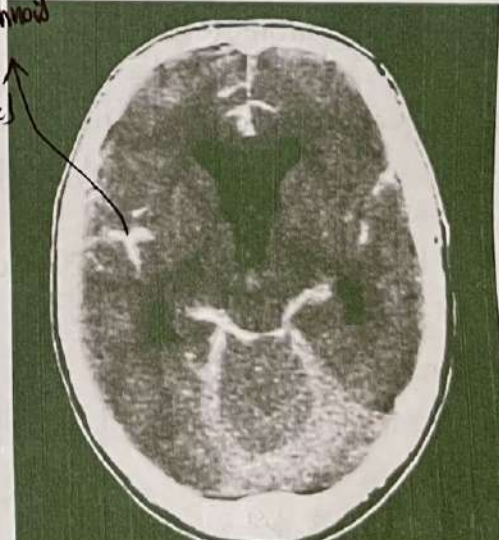
Case # ١

→ What is the correct attitude in that case?:

- a). Consult the Neurosurgeon
- b). Withdraw and revert the anticoagulant therapy.
- c). Treat HBP with iv labetalol
- d). Take some blood samples for culture and begin empiric antibiotic treatment
- ✓ e). All those measures are necessary

Case # ٢

bleeding
in subarachnoid
space
(hyperdense)



Case # 2

→ The correct management of our patient is:

- a). Perform a lumbar puncture to confirm the diagnosis of SAH.
- b). Consult a neurosurgeon
- c). Consider admission to ICU.
- d). Give laxative treatment.
- e). b, c & d are correct

(*) لوغت CT وبيہ Subarachnoid hemorrhage
Contraindication منوع LP اي لکھ لو مابيت لکھ اي LP

Intracranial Hemorrhage

1. Intracerebral and intracerebellar hemorrhage
2. Subarachnoid hemorrhage (SAH)
3. Subdural and epidural (extradural) hemorrhage

Traumatic $\sim$ Spontaneous like a Su like lipa x
hemorrhage
TBI $\rightarrow$ Su

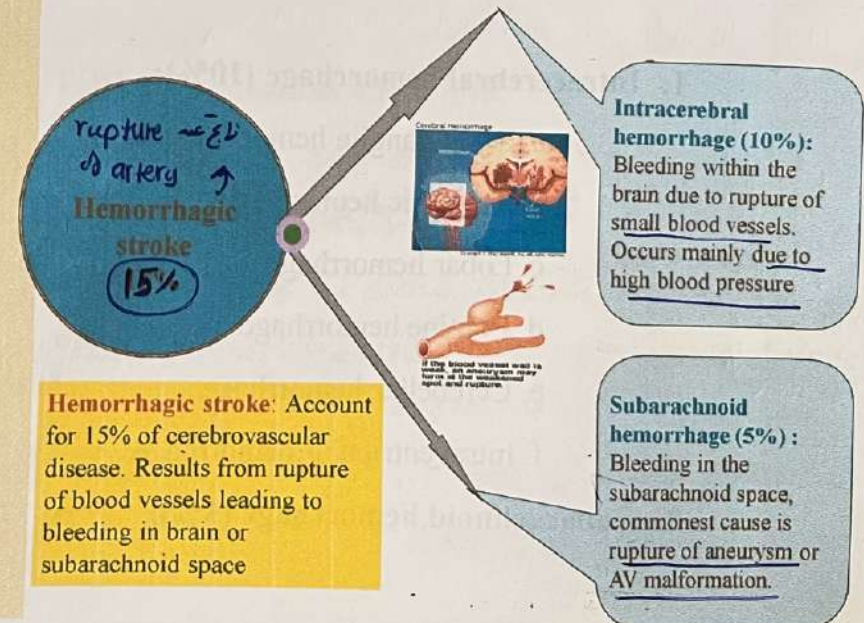
Case # 2

→ The correct management of our patient is:

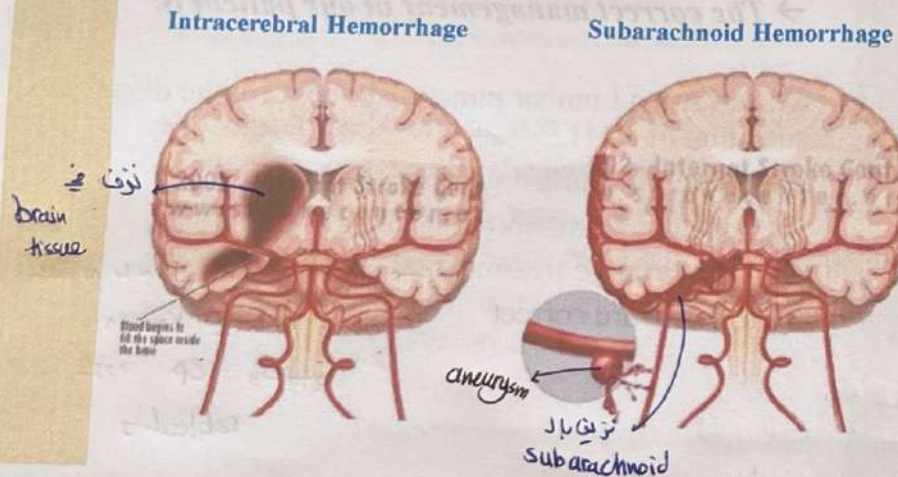
- a). Perform a Lumbar puncture to confirm the diagnostic suspicion of SAH.
- b). Consult a neurosurgeon
- c). Consider admission to ICU.
- d). Give laxative treatment. → Constipation: ٤٠٠ مل ماء
- e). b, c & d are correct

عقبات مایه خل
Constipation
و یخچال به حاله و
از د ۱۴ و یخچال
rebleeding

:Classification of Hemorrhagic Stroke



Hemorrhagic Stroke



Hemorrhagic Stroke

1. Intracerebral hemorrhage (10%):

- ✓ a. Basal ganglia hemorrhage.
- ✓ b. Thalamic hemorrhage.
- ✓ c. Lobar hemorrhage. → نزف في القشرة (Cortex)
- d. Pontine hemorrhage.
- e. Cerebellar hemorrhage.
- f. Intraventricular hemorrhage.

2. Subarachnoid hemorrhage (5%).

Causes of Hemorrhagic Stroke

- Intracranial aneurysm and AVM ruptures
- Hemorrhagic blood disease (Leukemia, Thrombocytopenia)
- Hypertension and DM with cerebral angiopathy
- Tumor of the brain complicated by hemorrhage
- Cerebral amyloid angiopathy
- Hemorrhagic transformation of ischemic stroke
- Acute bacterial meningitis
- Vasculitis (e.g. SLE)
- Idiopathic
 - over dose anticoagulant

Intracerebral Hemorrhage

نزف في داخل النسيج الدماغي (brain tissue)

- Intracerebral hemorrhage occurs within the brain substance.
- When the hemorrhage occurs deep in the hemisphere, rupture into the ventricular system is common
- Site of hemorrhage in hypertensive patients, up to 70% occur in the basal ganglia and thalamic region

* في middle cerebral artery branch اسمه Charcot artery هذا الشريان liable to hemorrhage ويقتل basal nuclei لأنه أكثر مكان بصير

منه نزف في حوضه

Site of Intracerebral Hemorrhage

1. Supratentorial hematoma: lobar, basal ganglia and thalamus.
2. Infratentorial hematoma: cerebellar and pontine hemorrhage, brain stem
- Infra ten. : أقل خطورة لكن الأخطر
suprat. : فوق العنق
Tentorium
Cerebellar hematoma
brain stem

- 

Hemorrhagic Stroke: Investigation

- AVM له القدرة اذا في aneurysm أود

سابقہ مقدمہ MRI ؟ تو مثالہ ہوم ومار نیو ٹرنی
نہ MRI مہیبہ الوم

CT of intracerebral hemorrhage

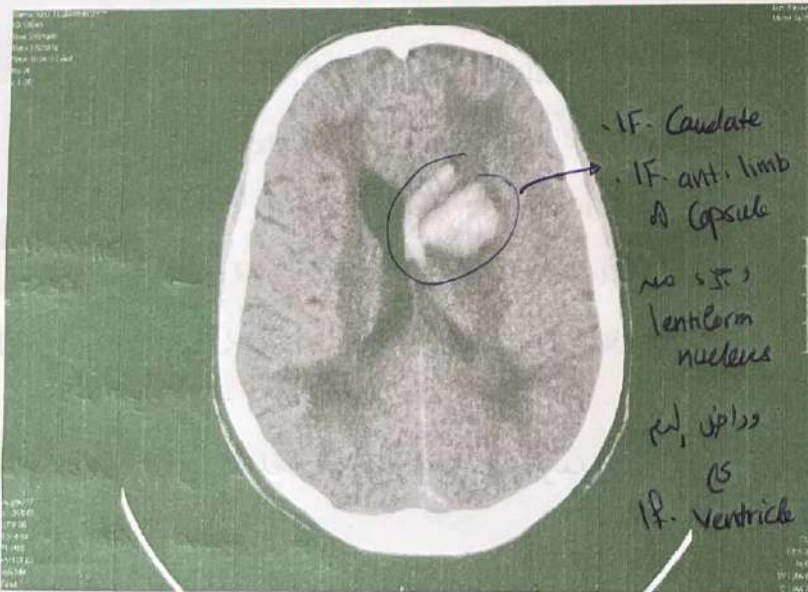
→ No contrast

- CT is more sensitive than MRI in the detection of acute intracranial bleeding.
- The fresh hematoma is a focus of homogeneous hyperdense area with perifocal edema. ^{↓ hypodense}
- The density of hematoma decreased and becomes isodense after 3-6 weeks.
- After complete absorption of the hematoma (third to sixth month), a hypodense defect can develop with CSF cyst.

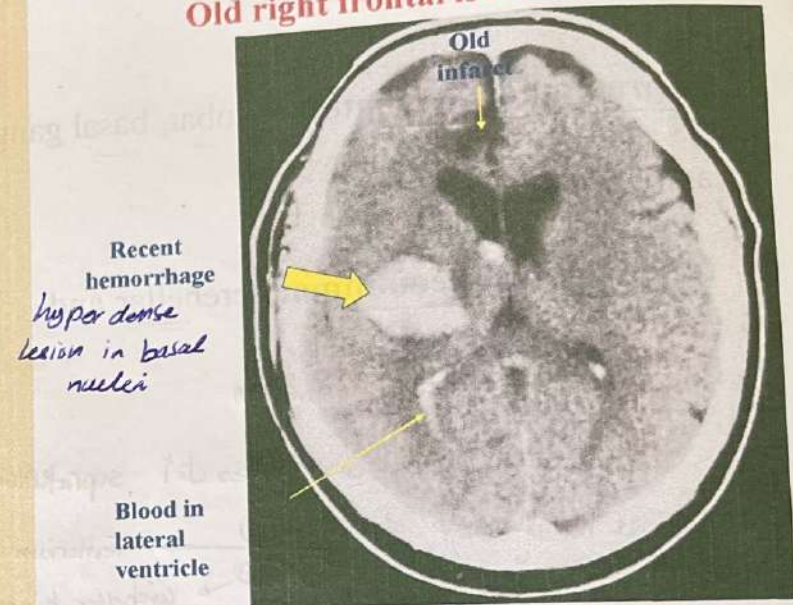
hematoma * في حاله ١١

hyperdense ← acute stage II
isodense ← Sub acute IF
hypodense ← Chronic IF

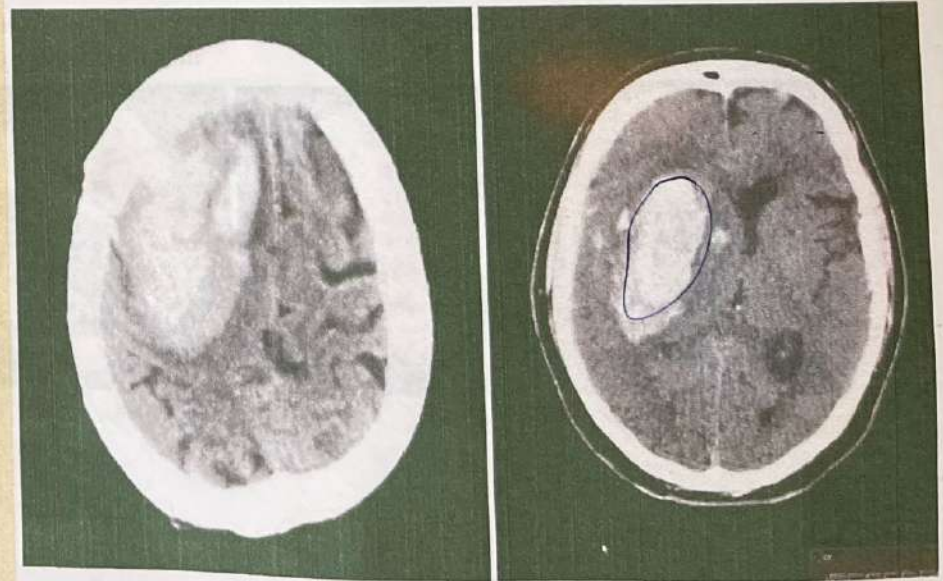
Left head of caudate nucleus hemorrhage with intraventricular involvement



Right lentiform nucleus hemorrhage with intraventricular involvement Old right frontal ischemic infarction



Massive right fronto-parietal hemorrhage



Bilateral intraventricular hemorrhage and ventricular dilatation



Intracerebral Hemorrhage "ICH" Score

- ❖ This scale for predict mortality after ICH.
- ❖ The ICH score is determined by adding the score from each component as follows:
- ❖ **Glasgow Coma Scale (GCS)** score 3 to 4 (= 2 points); GCS 5 to 12 (= 1 point) and GCS 13 to 15 (= 0 points).
- ❖ **ICH volume** $\geq 30 \text{ cm}^3$ (= 1 point), ICH volume $< 30 \text{ cm}^3$ (= 0 points).
- ❖ **Intraventricular extension** of hemorrhage present (= 1 point); absent (= 0 points).
- ❖ **Infratentorial origin** yes (= 1 point); no (= 0 points).
- ❖ **Age** ≥ 80 (= 1 point); < 80 (= 0 points).

Medical Complications of Stroke ^{ischemic hemorrhagic}

١.25 من رايكات عن سكر

- | | |
|---|--|
| <ul style="list-style-type: none"> • Recurrent stroke • DVT • Pulmonary embolism • UTI ✓ Pressure ulcers ✓ Spasticity and contractures. • Bladder dysfunction • Bowel dysfunction ✓ Aspiration pneumonia | <ul style="list-style-type: none"> • Dysphagia ✓ Seizure • Depression ✓ Central post-stroke pain syndrome ✓ Shoulder pain and dysfunction ✓ Malnutrition and dehydration ✓ (sepsis) |
|---|--|

(فترة نسبة الوفاة خلال شهر)

Thirty-day Mortality Rates

MR 13% ← 1 point
MR 27% ← 4 point
MR 100% ← 5 point

- ✓ Mortality rates for ICH scores of 1, 2, 3, 4, and 5 were **13%, 26%, 72%, 97%, and 100 %**, respectively.

- ✓ No patient with an ICH score of 0 died. → 0 point

* mortality عند hemorrhagic stroke
recovery وكنه اذا عاش مريض ال hemorrh
recovery نبعه افضل ..

Management of Hemorrhagic Stroke

A. Medical:

- تقليل العناية كل ساعة ،
الدوخة حذرية كل 4
- Care of comatose (4Bs): Bed, Bladder, Bowel and Breath
 - Care of fluid balance
 - Symptomatic treatment: antihypertensive, analgesic
 - Correction of fever
 - Cerebral dehydrating measures
 - Convulsion prevention: Epanutin (phenytoin), Tegretol

B. Surgical: Surgical evacuation of hematoma

external drainage $\rightarrow$ Ventriculostomy $\rightarrow$ Obstructive hydrocephalus $\rightarrow$ تدخل

Surgery is not recommended

Supratentorial hemorrhage with volume $<10 \text{ cm}^3$ and/or minor neurological deficit.

cerebellar hemorrhages $<3\text{-}4\text{cm}$ with good LOC

Patients with $\text{GCS} \leq 4$, except for cerebellar hemorrhage (surgery or external ventricular drainage should be considered in patients with very low GCS)

Hemorrhages in pons or midbrain.

Cerebellar hemorrhages $>3\text{-}4\text{cm}$ or with neurological deterioration, signs of brainstem compression, and/or hydrocephalus. Should be treated surgically as soon as possible

Surgery is recommended

Intracranial hemorrhage associated to an structural lesion such as aneurysm, AVMs, which are surgically accessible

Patients younger than 75 years old with a lobar ICH of medium-big size ($>50 \text{ cm}^3$) and/or presenting neurological deterioration

Management of Intracerebral Hemorrhage

➤ Supratentorial hematoma:

- Conservative
- Surgical evacuation in huge lobar hemorrhage when hematoma superficially

➤ Intracerebellar hematoma:

- May be conservative in small hematoma.
- Otherwise, urgent surgical evacuation

➤ Pontine hemorrhage:

- Usually conservative

➤ Intraventricular hemorrhage:

- Conservative
- Ventriculostomy in obstructive hydrocephalus

Prognosis of Intracerebral Hemorrhage

➤ Poor prognostic features:

- Large, deep hematoma
- Intraventricular and pontine hemorrhage
- Deep coma, pyrexia and convulsion

➤ Good prognostic features :

- Small superficial hematoma (lobar)
- Conscious patients, with normal temperature and without convulsion

➤ The mortality rate:

- from 25-60% (more than 90% in the patients with coma)

Spontaneous Subarachnoid Hemorrhage

- Spontaneous bleeding in the subarachnoid space due to rupture of intracranial aneurysm or AVM under high pressure.
- SAH accounts for (5%) of strokes
- SAH occurs in approximately 6-10 per 100 000 per year

× أكثر حالات موصوفة بالبلية ← 23 حالة لكل 100 000 نسمة بالسنه

Epidemiology of SAH

➤ Annual incidence of SAH:

- 2 cases per 100 000 population in China.
- 8 per 100 000 in Australia and New Zealand.
- 22 per 100 000 in Finland.
- 23 per 100 000 in Japan.

➤ The incidence of SAH increases with age, occurring most commonly between 40 and 60 years of age.

➤ SAH is affecting 30 000 Americans each year.

➤ Black Americans are at higher risk than white Americans.

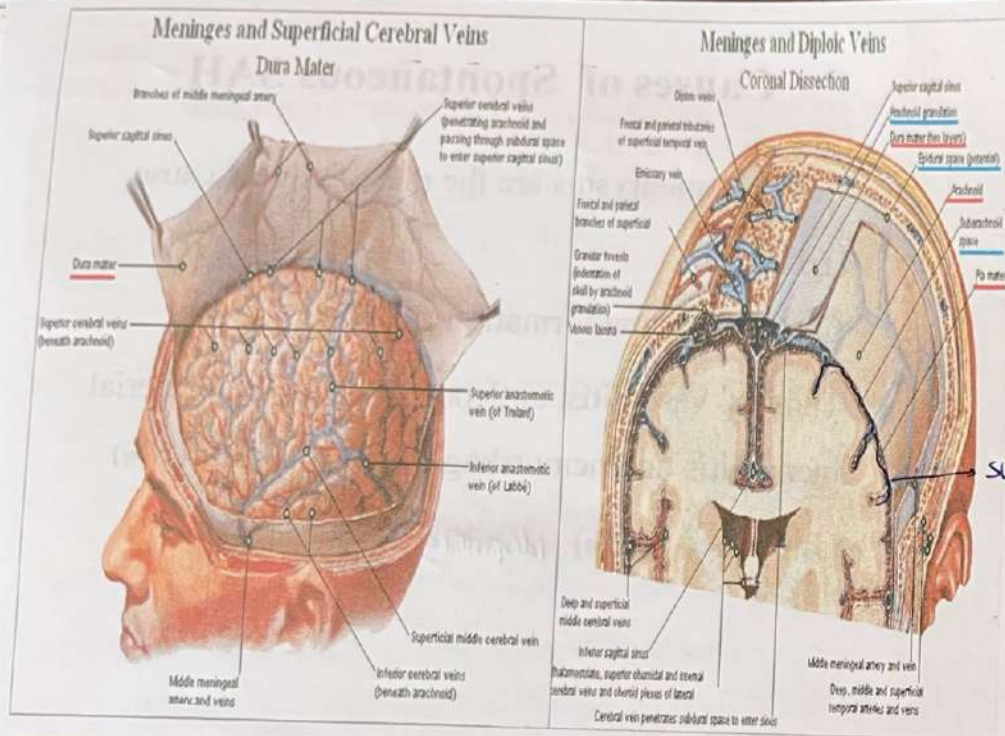
white < Black

Causes of Spontaneous SAH

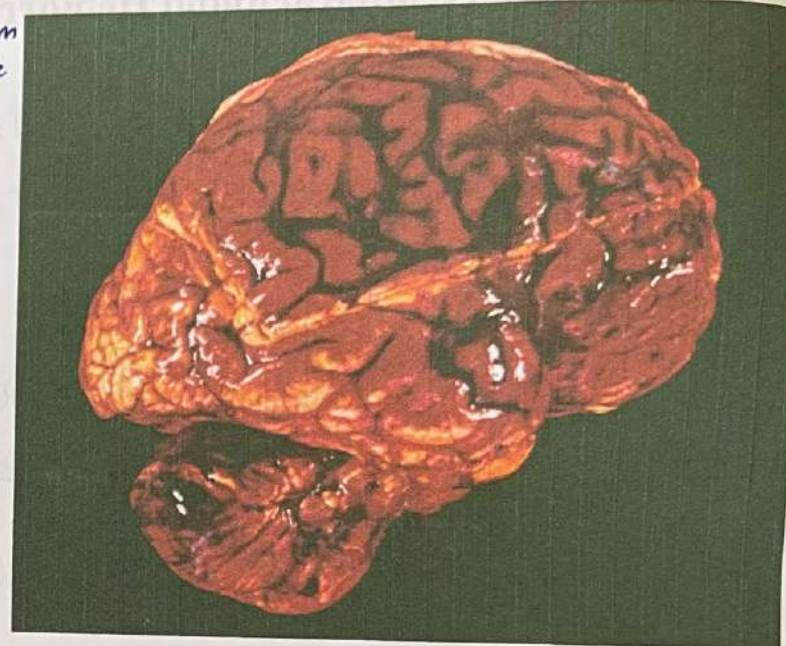
- Cerebral aneurysms are the most frequent cause (70-75%)
- Cerebral AV malformation (5%)
- Tumors, vasculitis, anticoagulants, acute bacterial meningitis and hemorrhagic blood disease (5%)
- Undefined (15%) *Idiopathic*

Risk Factors of SAH

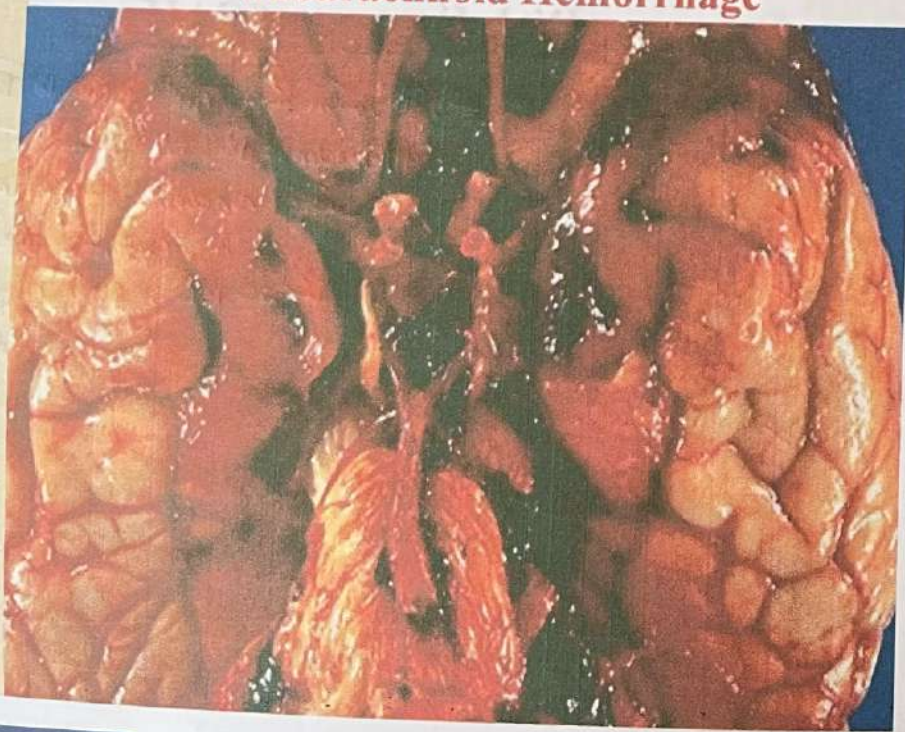
- ✓ Hypertension. *DM × ما يعتبره risk ، لك دكتور ليراني*
- ✓ Smoking. *أز ، بقولك DM يقل atherosclerosis*
- ✓ Female sex. *بحير استرابة nonelastic فيك ريبور rupture*
- ✓ Family history of cerebrovascular disease. *سبب الهمالة هاه دراسات بنقد رشتا*
- ✓ Postmenopausal state. *نقولهم لا ...*
- ✓ Heavy alcohol use.
- ✓ Use of cocaine.
- ✓ DM does not appear to be a risk factor for SAH.



سلسلا 1.75 ← **Subarachnoid Hemorrhage**
aneurysm rupture



Subarachnoid Hemorrhage



Clinical Features of SAH

Thunderclap headache

- Sudden onset of severe headache
- Stiff painful neck due to meningeal irritation
- Nausea, repeated projectile vomiting, vertigo, fever
- Confusion, coma
- Convulsion
- Positive meningeal irritation signs

Complications of SAH

- Rebleeding: bad prognosis
- Ischemic infarction: due to intracranial vasospasm سبب الألم الشديدي
والزنجير
- Seizures: due to cortical irritation
- Hydrocephalus: due to impaired CSF drainage by blood due to clot in Monroe foramen, aqueduct, ~~basal~~ / uschka
- Hyponatremia: due to inappropriate secretion of antidiuretic hormone (ADH) نموذج الوراثة الجينية
- Intracranial hypertension with brain stem herniation and death
- Hypothalamic dysfunction and pituitary gland insufficiency.

Classification of SAH

Hunt and Hess grading system:

- Grade 1** - Asymptomatic or mild headache
- Grade 2** - Moderate-to-severe headache, neck rigidity, and no neurological deficit other than possible cranial nerve palsy
- Grade 3** - Mild alteration in mental status (confusion, lethargy), mild focal neurological deficit
- Grade 4** - Stupor and/or hemiparesis
- Grade 5** - Comatose and/or decerebrate rigidity

World Federation of Neurosurgeons (WFNS) scale:

- Grade 1** - GCS of 15, motor deficit absent
- Grade 2** - GCS of 13-14, motor deficit absent
- Grade 3** - GCS of 13-14, motor deficit present
- Grade 4** - GCS of 7-12, motor deficit absent or present
- Grade 5** - GCS of 3-6, motor deficit absent or present

Investigation of SAH

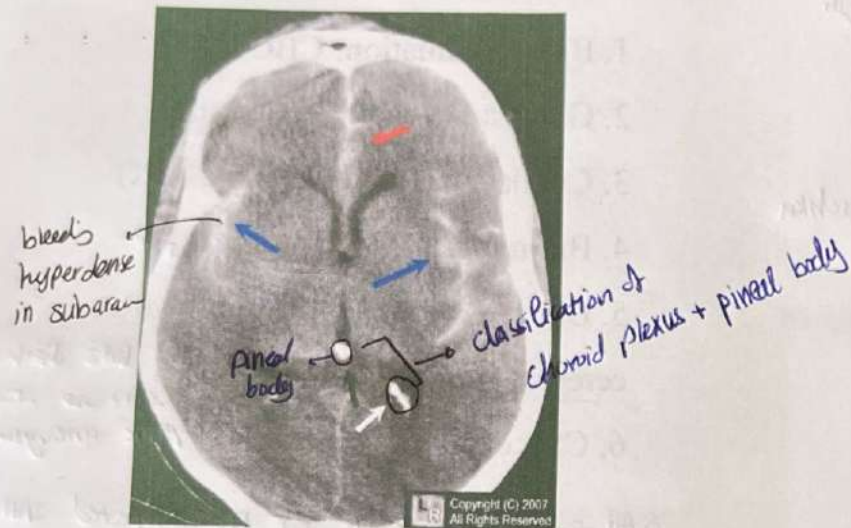
1. Blood evaluation: CBC
2. Glucose level, coagulate state
3. Cardiac evaluation: X-ray, ECG
4. Brain imaging: CT scan الأشعة
5. Blood vessel visualization: MRA, cerebralangiography هو الأفضل نفاذا لكل الحالات
عند قدر لها في
6. CSF examination. rupture aneurysm, AVM

* حاله Suspected SAH على CT مابيه، والدراسة بوقت SAH قد تكون minimal SAH فقط هنا LP صندوق لملء بار CSF

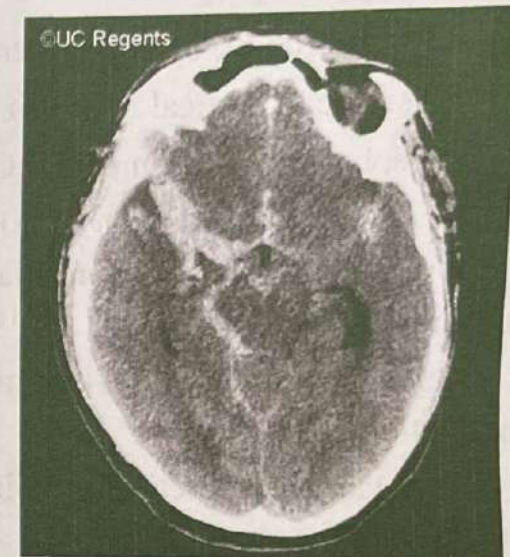
Modified Grading System of **Fischer** (CT scan appearance)

- Grade 0** - No SAH or IVH. توقنا لو شائيه هيفد LP
- Grade 1** - focal or diffuse thin (< 1 mm) SAH, without IVH. هيو بييه بار CT بيني شيع اكل LP
- Grade 2** - focal or diffuse thin SAH, with IVH. < 1mm
- Grade 3** - focal or diffuse thick (> 1 mm) SAH, without IVH.
- Grade 4** - focal or diffuse thick SAH, with IVH.

Diffuse subarachnoid hemorrhage



Subarachnoid hemorrhage in a patient with the sudden onset of a severe headache, repeated vomiting and stiff neck



Two intracranial aneurysm

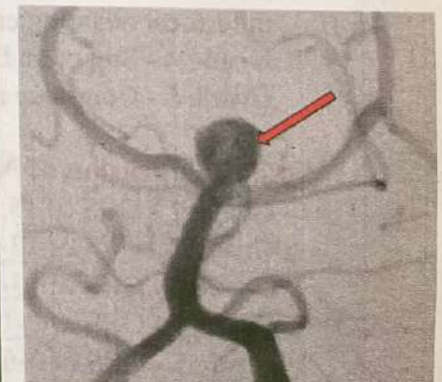


Cerebral Angiography

Aneurysm of right vertebral artery



Large aneurysm located at the tip of the basilar artery



Cerebral Angiography

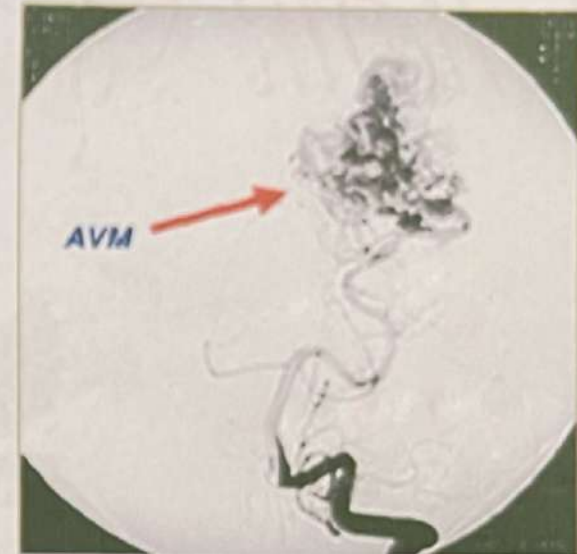
Rupture of Aneurysm



After coil embolization



AVM - Arteriovenous Malformation



Management of SAH

A. Medical:

- ✓ ➤ Care of comatose (4Bs): Bed, Bladder, Bowel and Breath
- ✓ ➤ Bed rest , passive exercise to prevent OVT, PE
- Symptomatic treatment: antihypertensive, insulin, analgesic
- Prevention of cerebral ischemia: Nimotop (nimodipine), → ^{تجنب} Vasospasm
high fluid intake NS ^{دراسة حالة كورتية, في حالة سلا}
- Cerebral dehydrating measures ^{دراسة حالة كورتية, في حالة سلا}
- Anticonvulsant therapy "controversial": Epanutin (phenytoin), Tegretol
- Correction of fever 1000 mg / 6h Paracetamol → ^{بقتل الحرارة, الصداع}
- Prophylaxis of constipation

B. Surgical:

- Ventriculostomy in patients with obstructive hydrocephalus → ^{فقرن الزئبق}
- Direct clipping of the aneurysm neck
- Endovascular techniques (coil embolization) ^{سكروا ال aneurysm}

Physiotherapy and Rehabilitation of Stroke

- Prevention of medical complications
- Prevention of deconditioning and contractures
- Training of new skills

