
بسم الله الرحمن الرحيم

Stroke

(brain attack or CVA)

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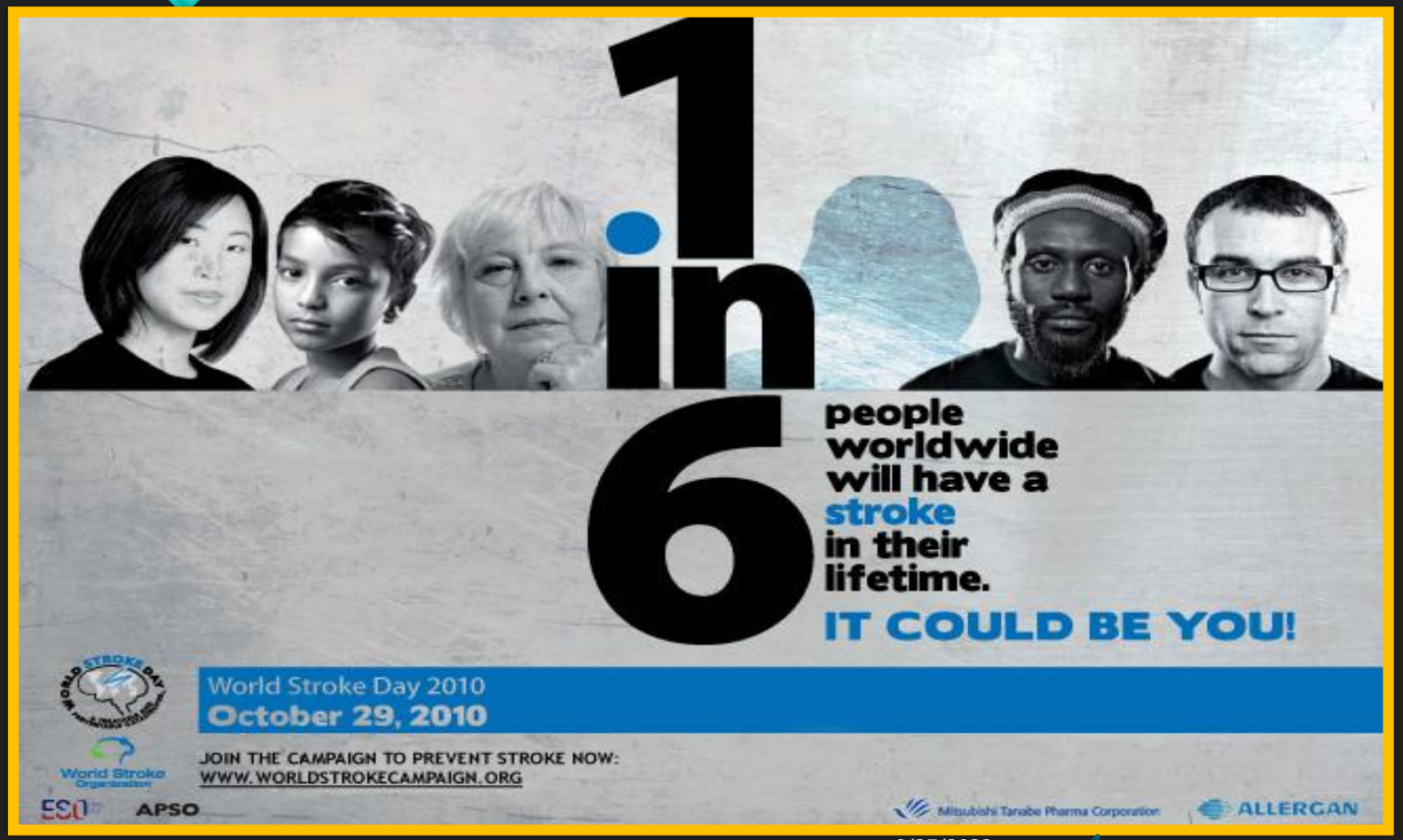
Introduction 1

- **Stroke is as:**
  - second leading cause of death
  - every 6 sec, 1 mortality
  - Stroke is most common cause of disability in adults
  - Stroke is 2nd leading cause of dementia
  - Stroke is most common cause of epilepsy in the elderly
  - Stroke is a frequent cause of depression
- Deaths from it will nearly double by 2030.

29 OCTOBER, 7 ABAN, WORLD STROKE DAY,

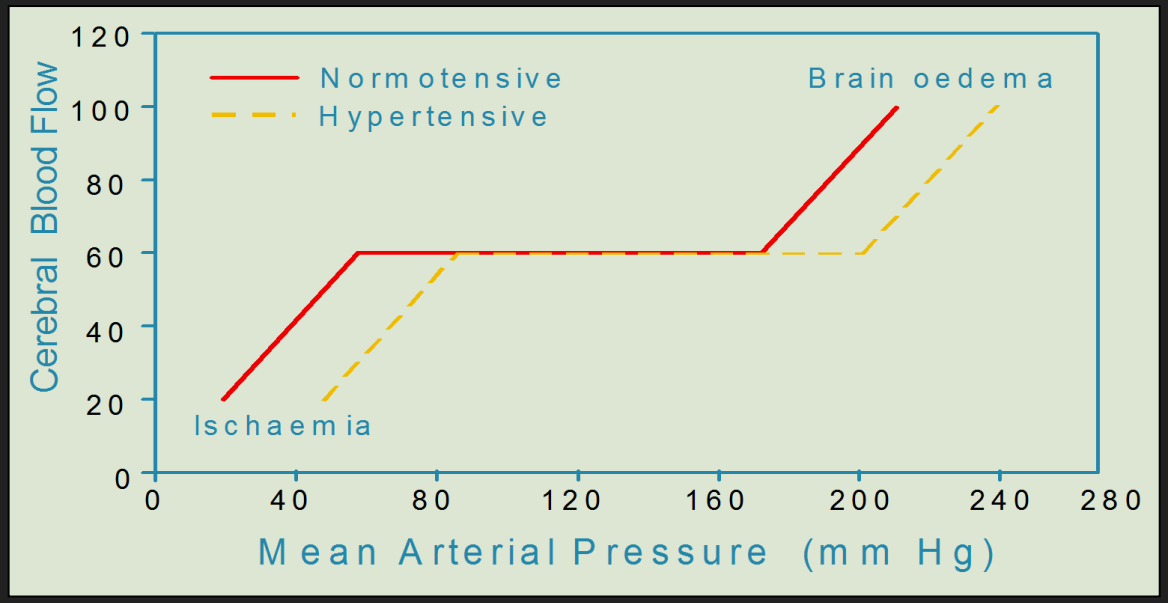


Physiologic noes:

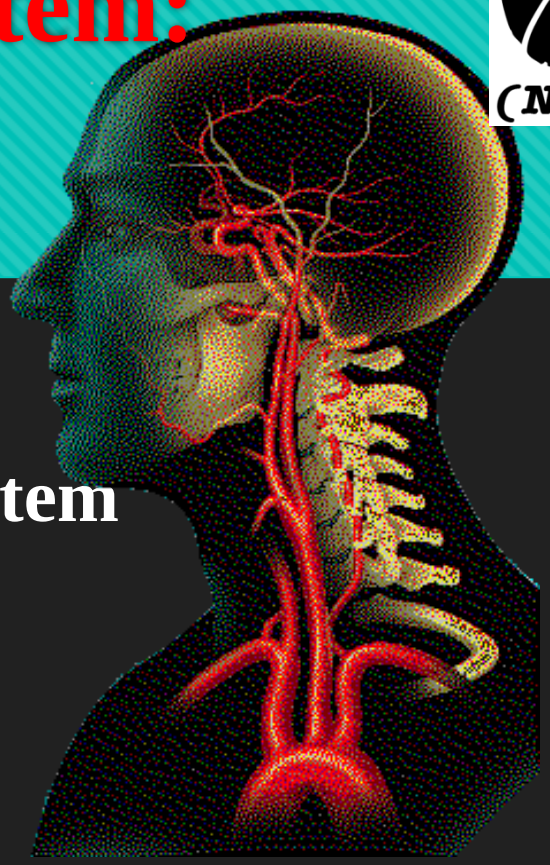
- Brain weight :1500 gr (2% of TBW)
- But reach about 18% of cardiac output
- Each 100 gr of brain need ;
  - 55 ml blood flow /min (CBF)
  - 5 mg glucose / min
  - 3.5 ml oxygen / min

Cerebral Autoregulation :

- Ability of cerebral blood flow to remain constant in the face of changes in cerebral perfusion pressure



Cerebral Arterial System:

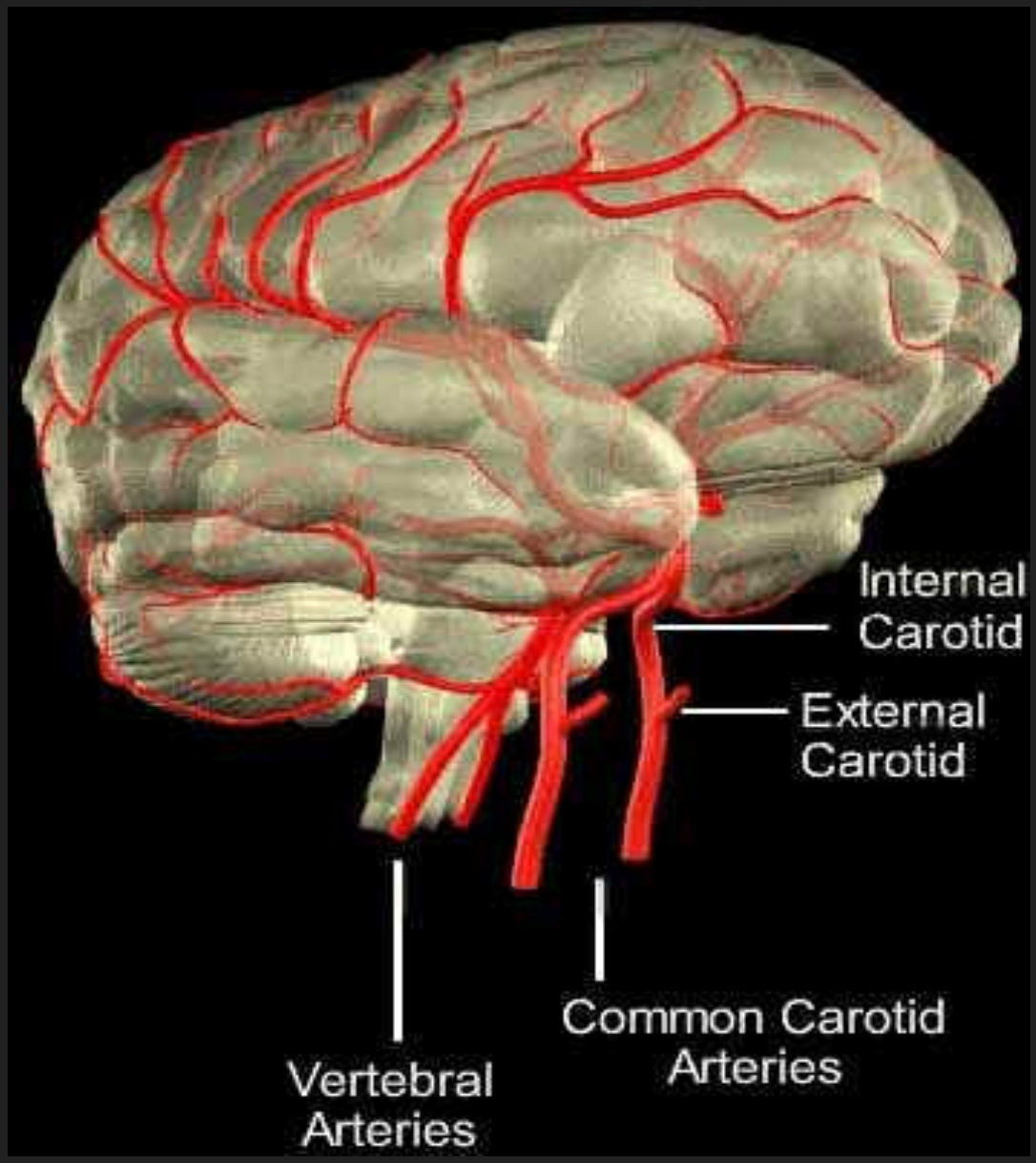


1. **Anterior circulation or carotid system**

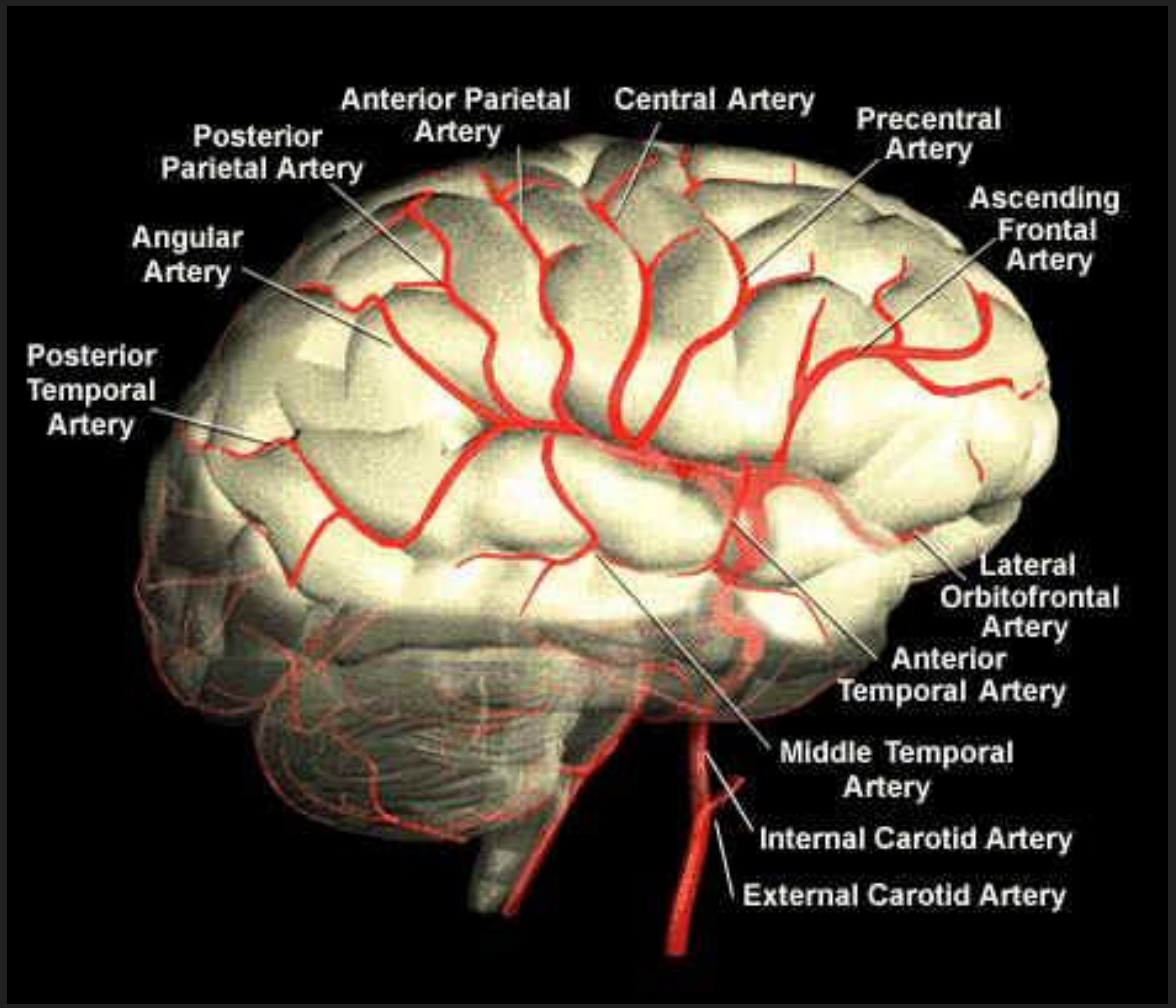
   350 ml/min

2. **posterior circulation or or vertebrobasilar system**

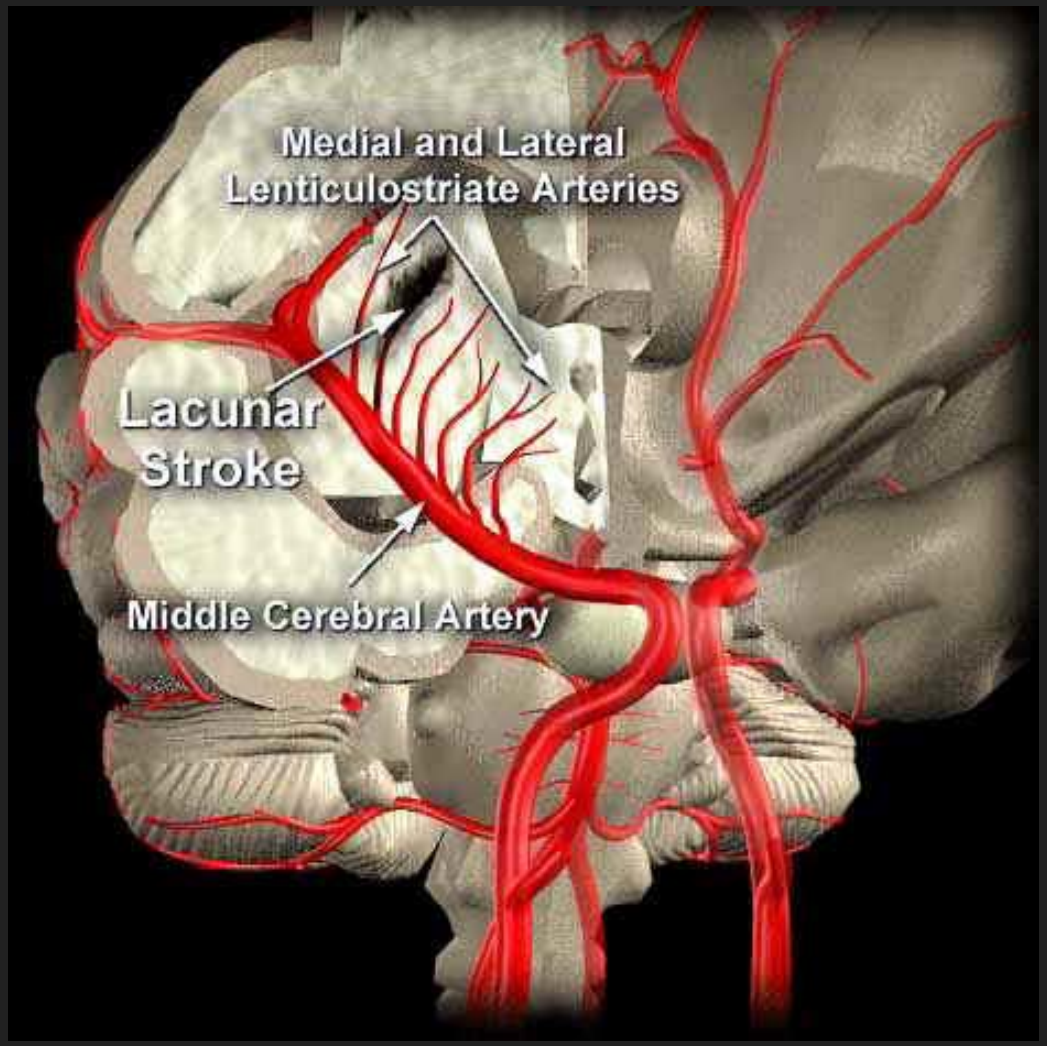
   100-200 ml/min


Internal Carotid
External Carotid
Common Carotid Arteries
Vertebral Arteries

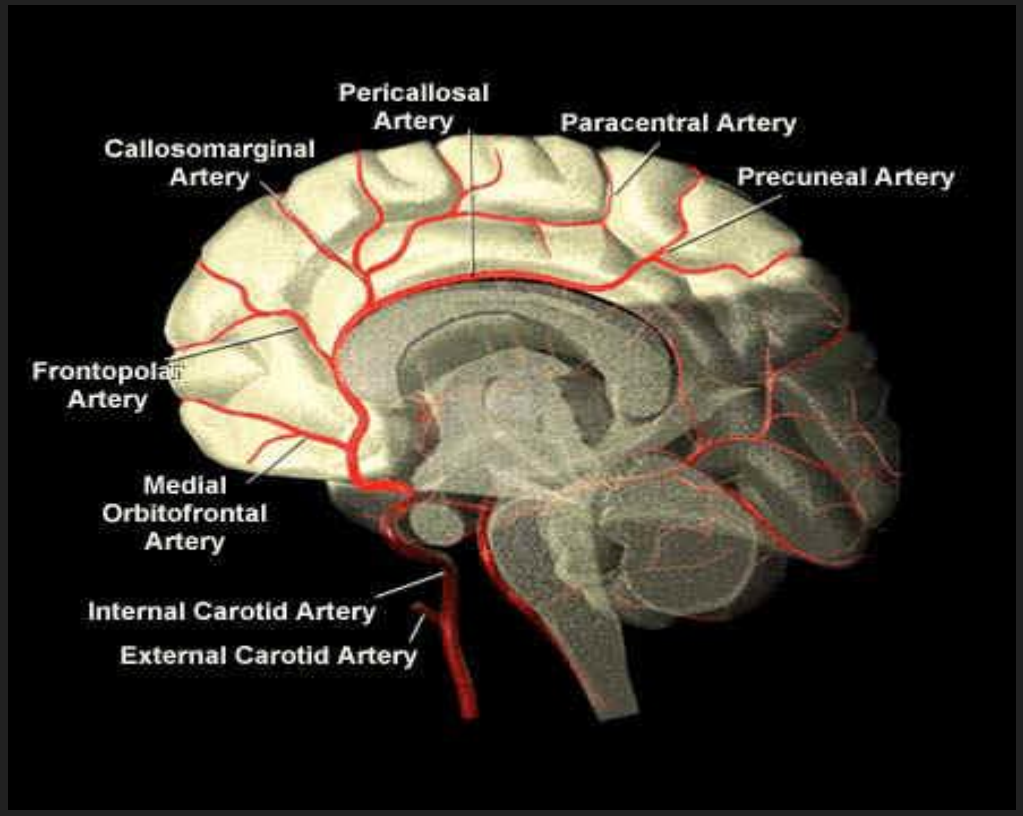
Middle cerebral artery territory (MCA):

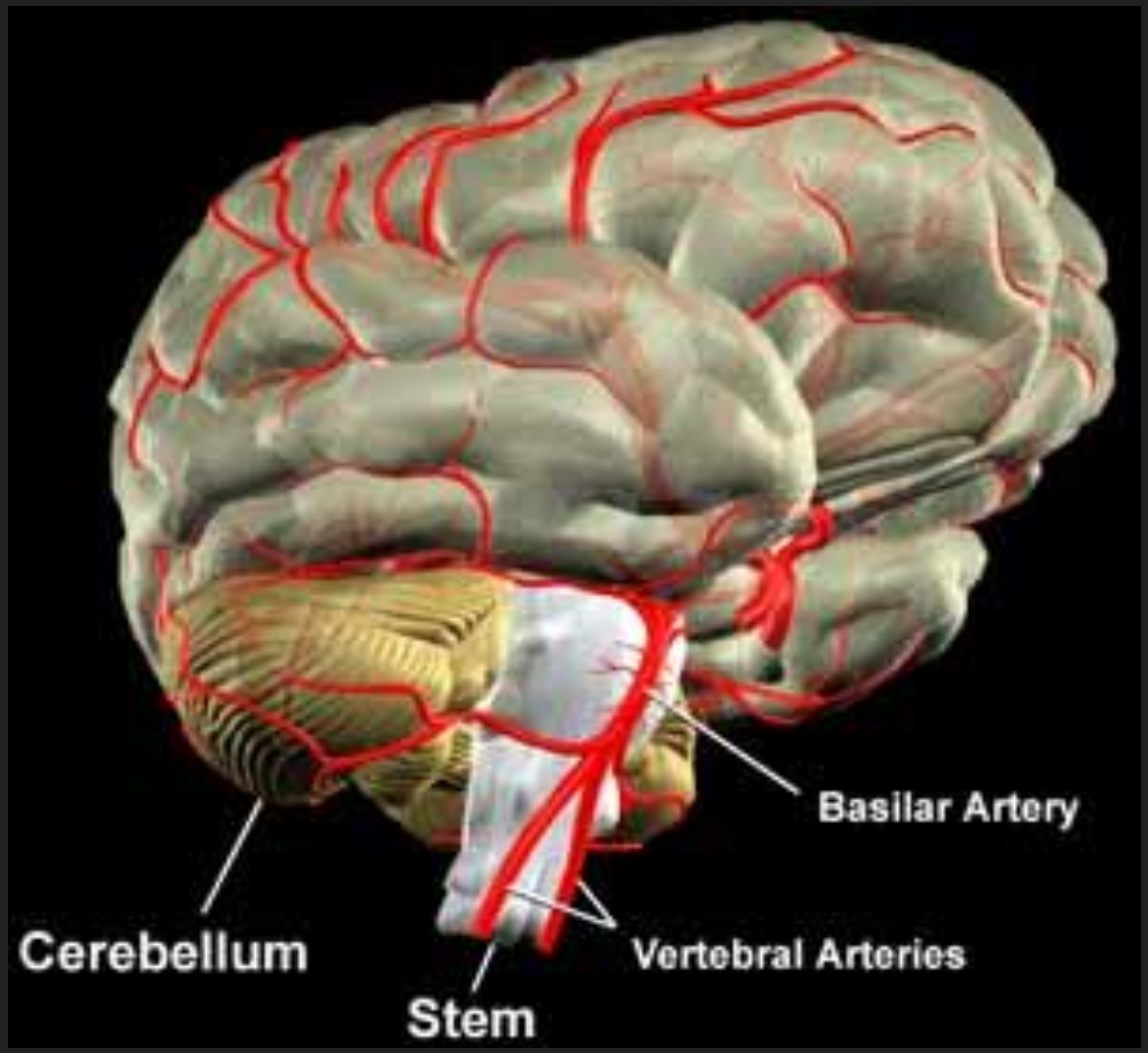


Lenticulostriate arteries

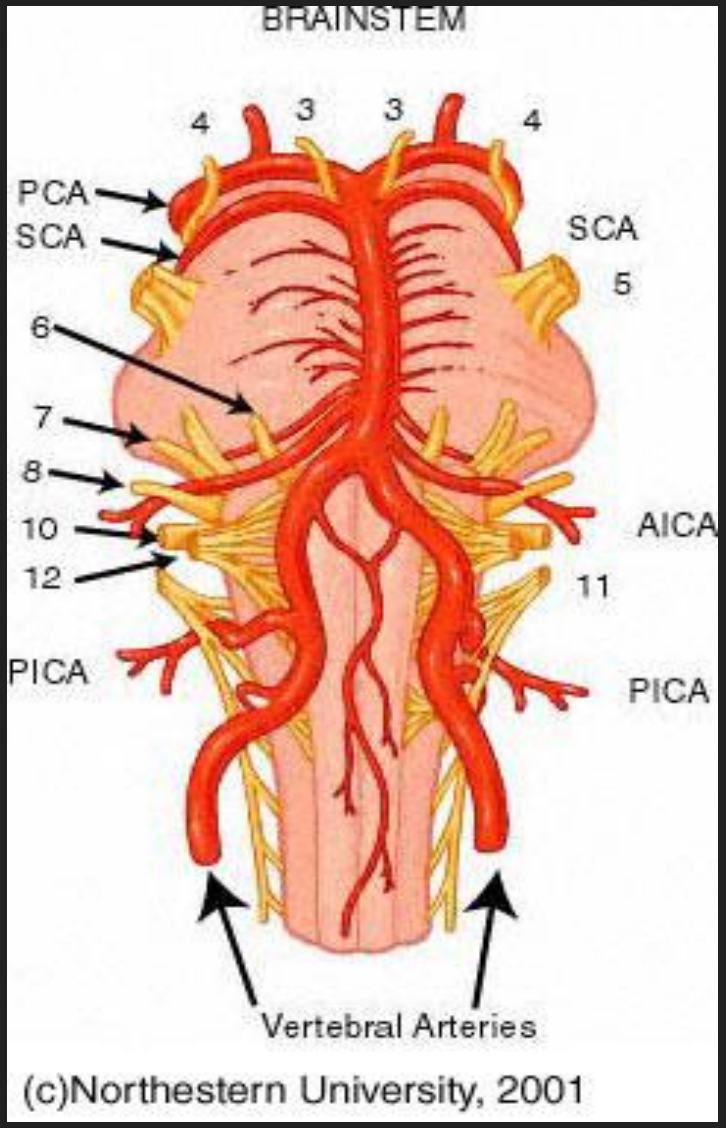


Anterior cerebral artery territory (ACA):

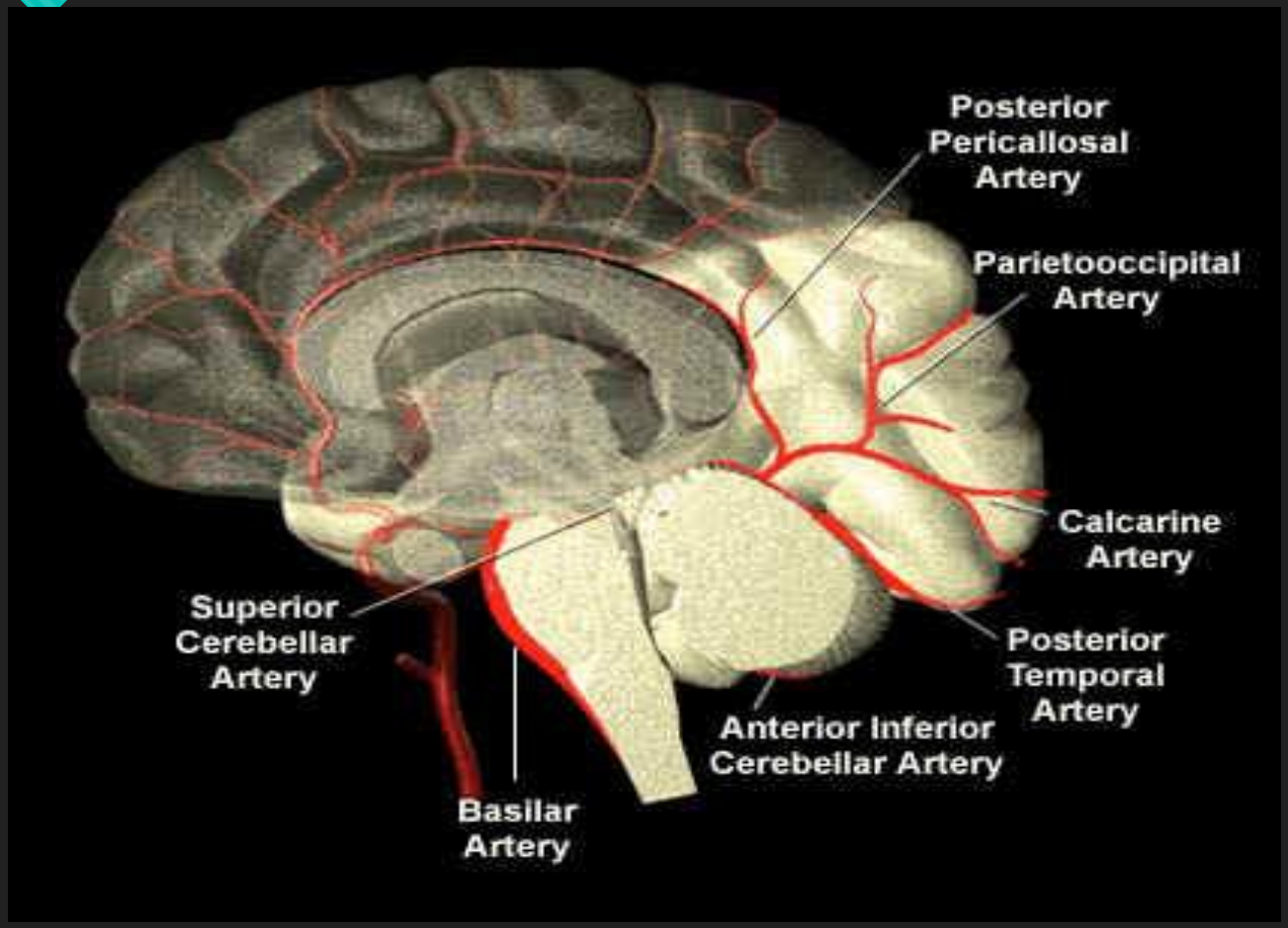



Basilar Artery
Cerebellum
Vertebral Arteries
Stem

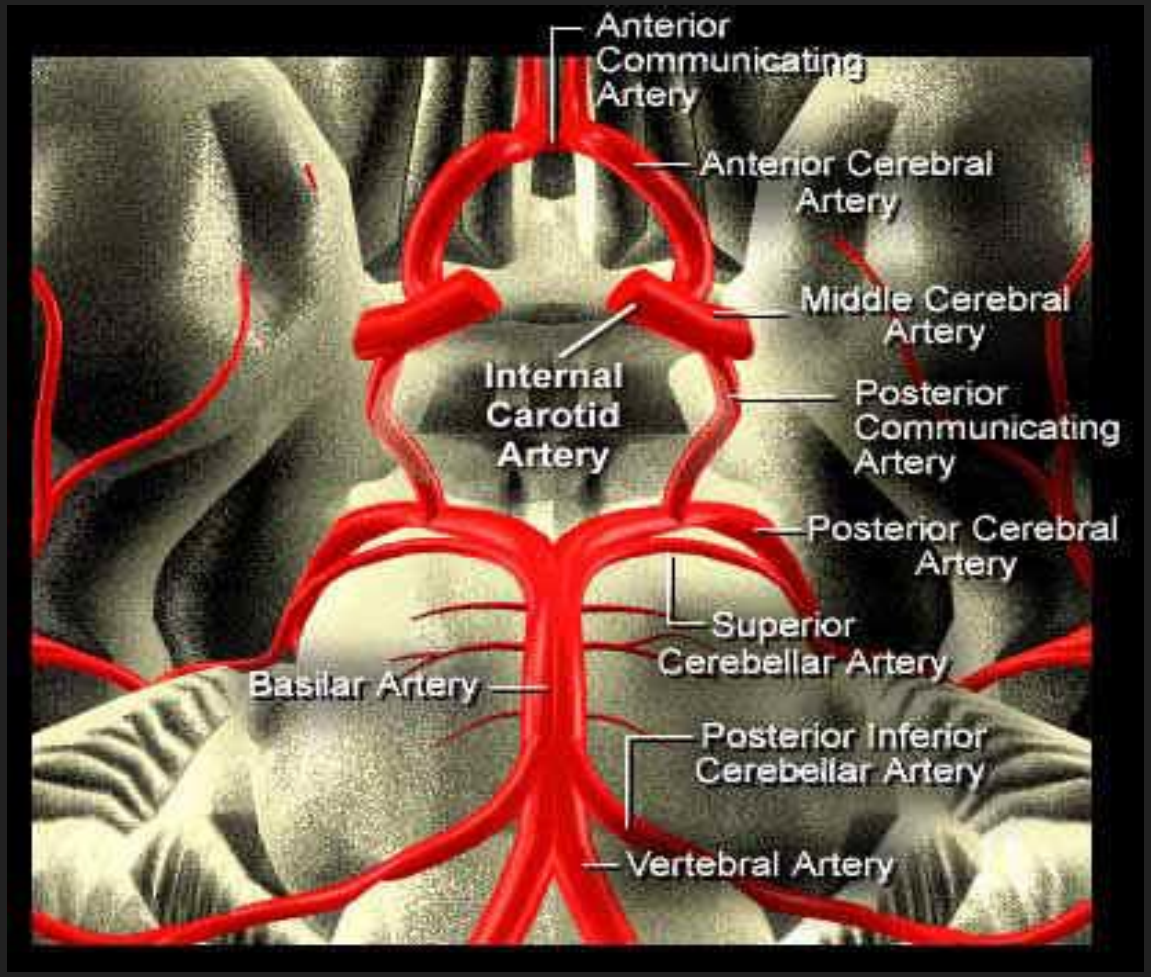
Vertebrobasilar territory



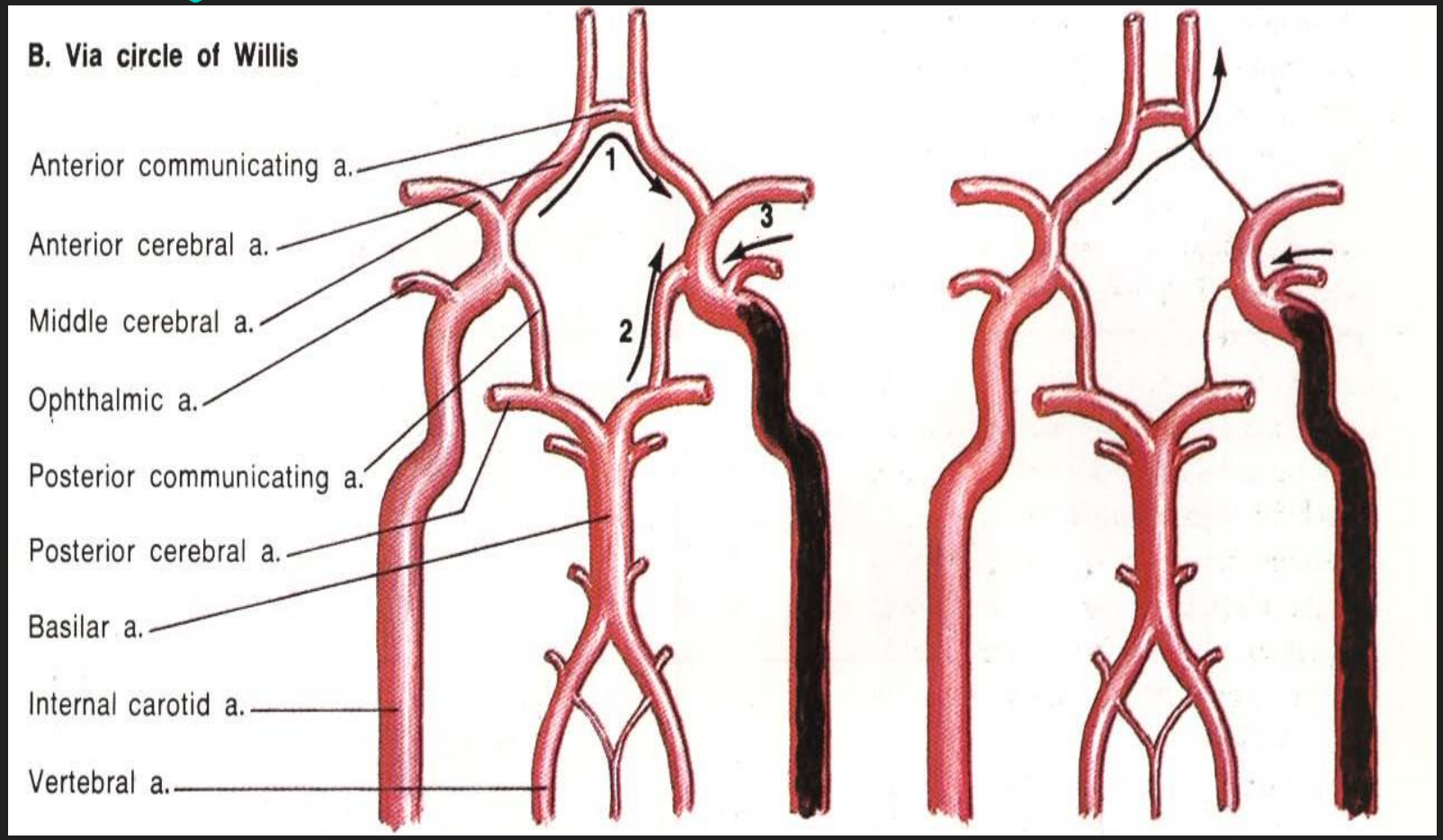
Vertebrobasilar arteries territory



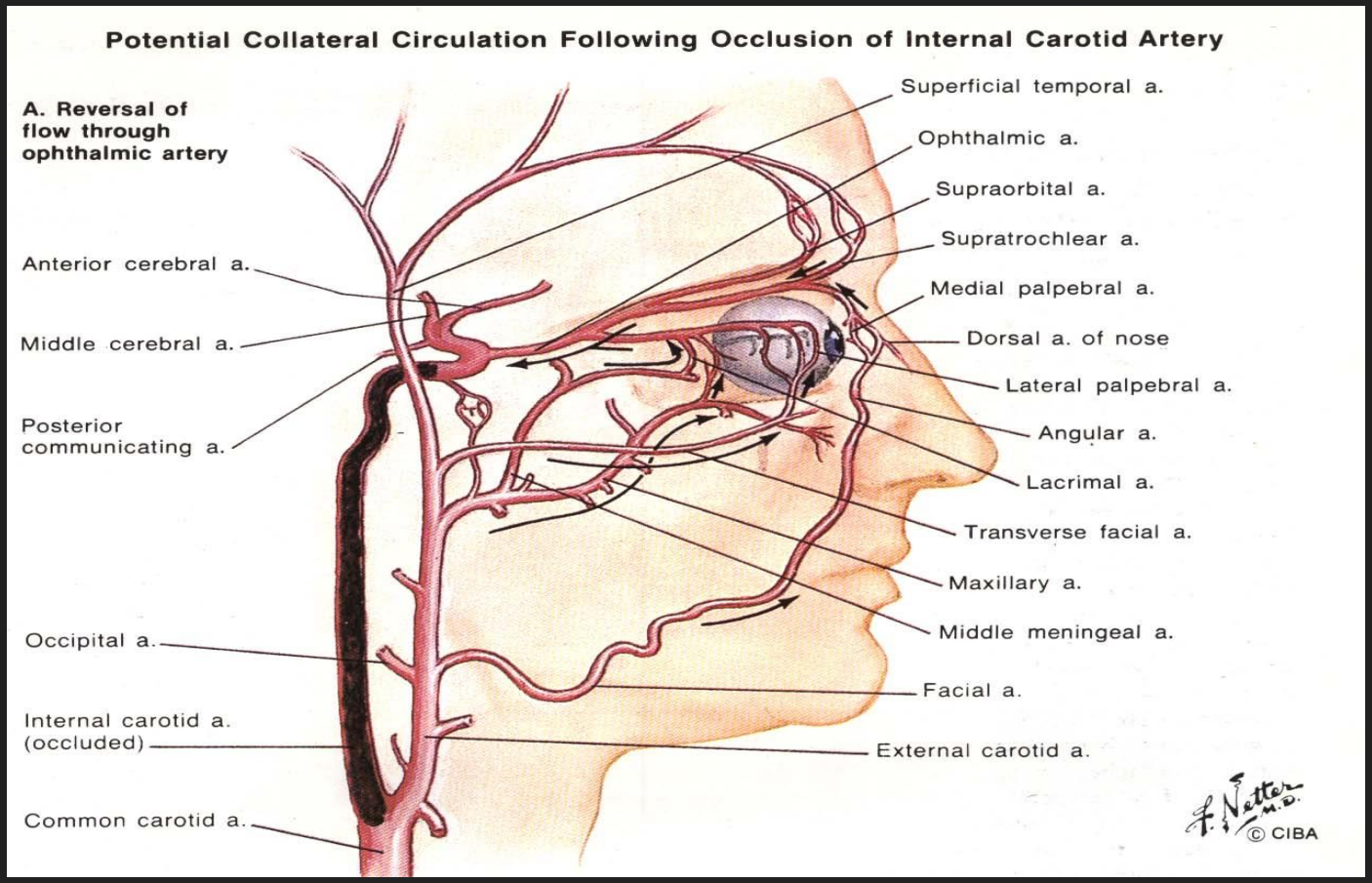
Circle of Willis



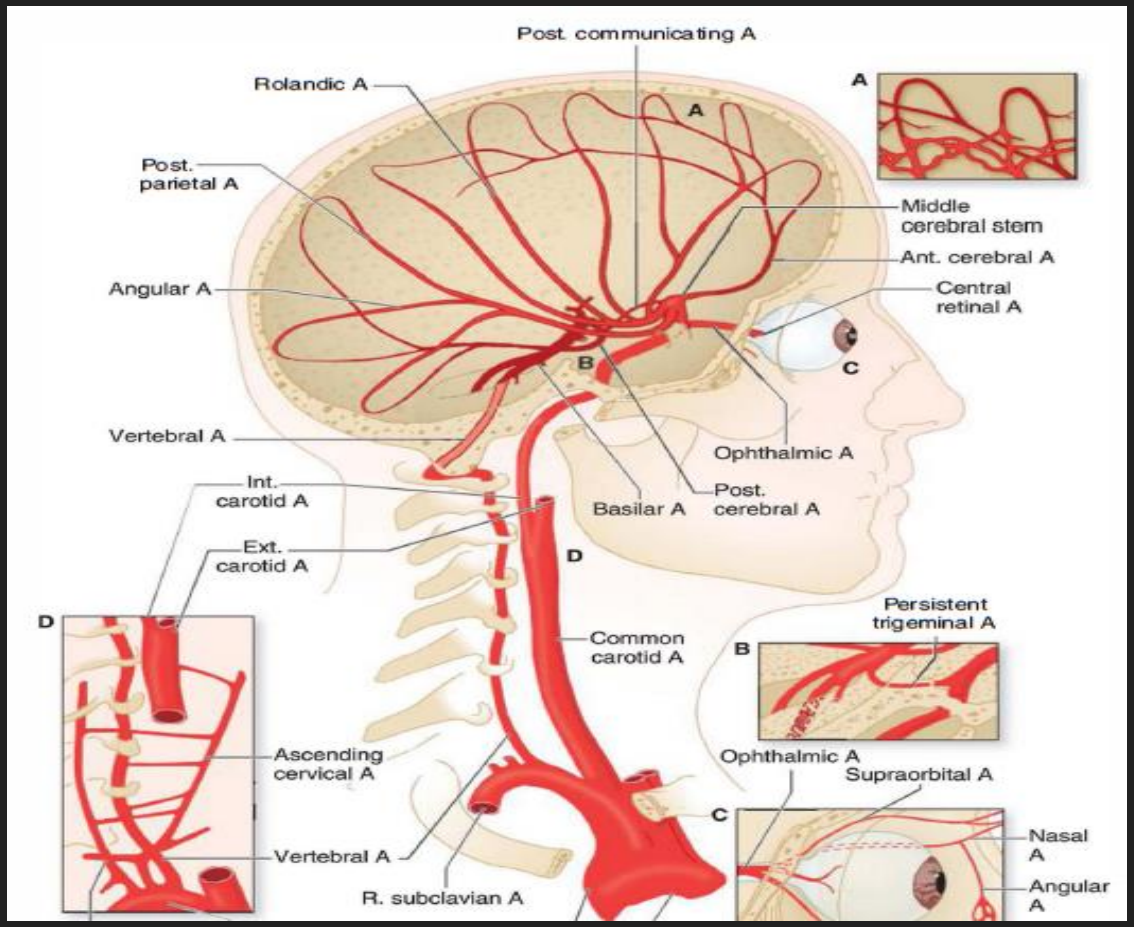
Role of Willis Circle:



Ophthalmic artery collateral:



Cerebrovascular collaterals:



Cerebral Venous System:

Internal & cortical veins

↓

Venous sinuses

↓

Internal jugular veins

Normal Venous Anatomy

Neurovascular Examination

- Inspection
- Palpation
- Auscultation
- BP measurement

Neurovascular Examination- Inspection

Neurovascular Examination-
OPHTHALMOLOGICAL EXAMINATION

- Ophthalmological Findings
  - Hypertensive retinopathy
  - Diabetic retinopathy
  - Papilledema
  - Central Retinal Artery Occlusion
  - Retinal Hemorrhage
  - Retinal Emboli
- Horner Syndrome: partial/ complete

Neurovascular Examination- OPHTHALMOLOGICAL FINDINGS

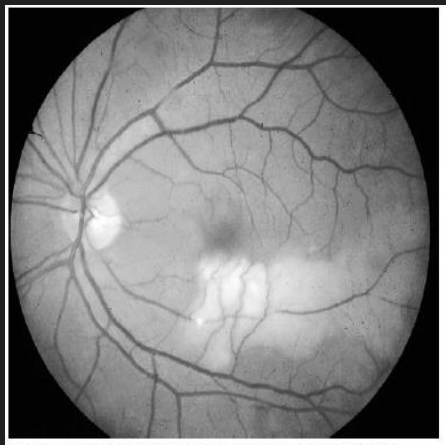


Figure 2-4. Retinal embolus with secondary retinal infarction.

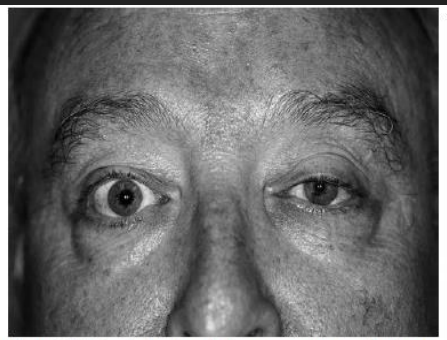
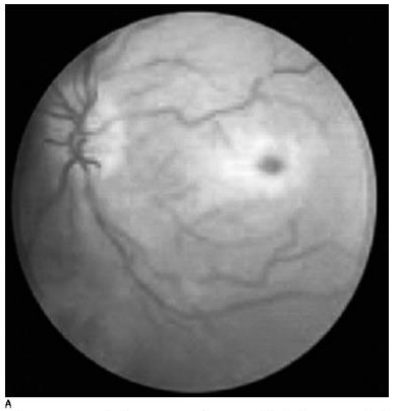


Figure 2-5. Left miosis and ptosis due to an oculosympathetic paresis, or partial Horner syndrome. Photograph courtesy of Dr. Carol Zimmerman.



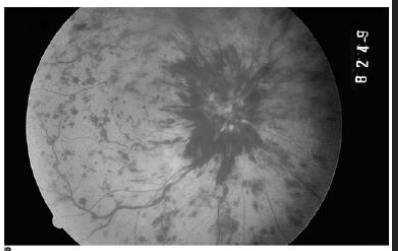
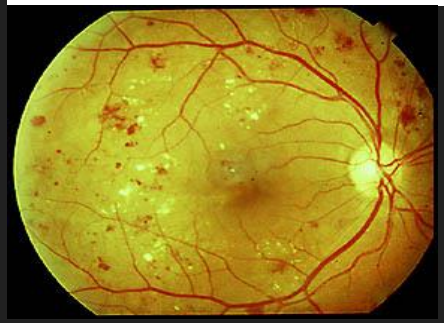
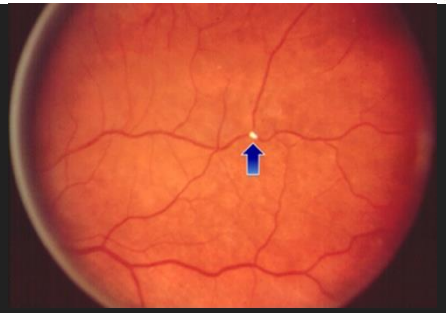
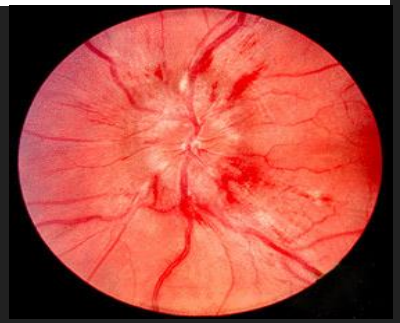


Figure 2-3. A: Retinal appearance after a central retinal artery occlusion. Note the cloudy appearance of the retina, the indistinctness of the retinal arteries, and the cherry-red macular lesion. B: Retinal findings following thrombosis of the central retinal vein include retinal edema and perivenous hemorrhage.







Causes of transient monocular blindness

Embolism
- Carotid artery bifurcation stenosis
- Cardiac mural thrombus
- Intracardiac tumor
- Foreign body
- Air embolism

Hemodynamic
- Atheromatous disease
- Takayasu arteritis
- Cardiac failure, acute hypovolemia
- Microvascular (e.g., Susac syndrome)

Ocular
- Anterior ischemic optic neuropathy
- Central or branch retinal artery occlusion
- Central retinal vein occlusion
- Glaucoma
- Retinal detachment
- Vitreous hemorrhage

Neurologic
- Leber hereditary optic neuropathy
- Optic neuritis
- Optic nerve or chiasm compression
- Migraine

Psychiatric
- Somatoform disorder
- Malingering

Hematologic
- Hyperviscosity syndromes
- Thrombocytosis
- Polycythemia
- Coagulopathy
- Hemoglobinopathy (e.g. sickle cell disease)

Toxic
- Methanol

Neurovascular Examination- Inspection

- Skin / mucosal color, angiomatosis,….
- Visible pulsations in neck:
  - the external carotid system
  - Internal carotid system
- Other finding in other systems

Neurovascular Examination- Palpation

Neurovascular Examination- Palpation

- **Carotid system:**
  - Relaxed neck, no compression, Risk of vasovagal response / emboli
  - CCA, Bulb, ECA branches
- **Subclavian artery**
- **Radial arteries**
- **Other peripheral pulses**
- **Notes**:
  - Thrill
  - Asymmetry of pulses, Asynchrony
  - Tenderness
  - The reappearance of previously absent pulses suggests spasm, recanalization of arteries, or temporary diversion of blood flow.

Neurovascular Examination- Auscultation

Neurovascular Examination- Auscultation

- Bruits at the carotid bifurcation occur in about 7% of patients over the age of 65 years.
- A bruit is but an indication of non-laminar flow and can have many causes.
- First cardiac study, then carotid & SA, Vertebra-Basilar system examination.
- Manure in carotid exam.
- Bruit due to stenosis means at least 50% stenosis
- With increase of stenosis, pitch and duration of stenosis increases
- If systolic + diastolic: means severe stenosis
- Occlusion abolishes bruit in the site, but may new bruit in other arteries

Causes of Cervical Bruits

Arterial stenosis

Atherosclerosis

Fibromuscular dysplasia

Neoplasm

Radiation vasculopathy

Arterial dissection

Arteritis

Occlusion with collateral channels

- Padget disease of skull

Hemodynamic factors

- Flow augmentation due to contralateral stenosis
- Hyperthyroidism
- Hemodialysis
- Kinks and coils of arteries

- Anemia
- Arteriovenous (AV) shunts
- AV malformation
- AV fistula

Physiologically increased flow

- Childhood
- Pregnancy
- Fever

Cardiac factors

- Increased cardiac output
- Transmitted murmur (especially for aortic valvular heart disease)

Neurovascular Examination- Blood Pressure Measurement

Neurovascular Examination-Blood Pressure Measurement-1

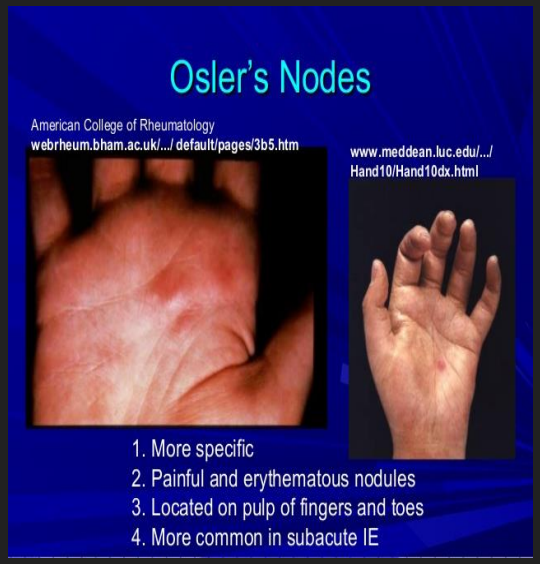
- Arterial BP should be measured and compared in ***each arm***.
- A difference ***> 20 mm Hg*** in the systolic pressures between the two arms is strongly suggestive of subclavian artery disease.
- The BP may fall precipitously in these individuals when the arm with the obstruction is ***exercised***.

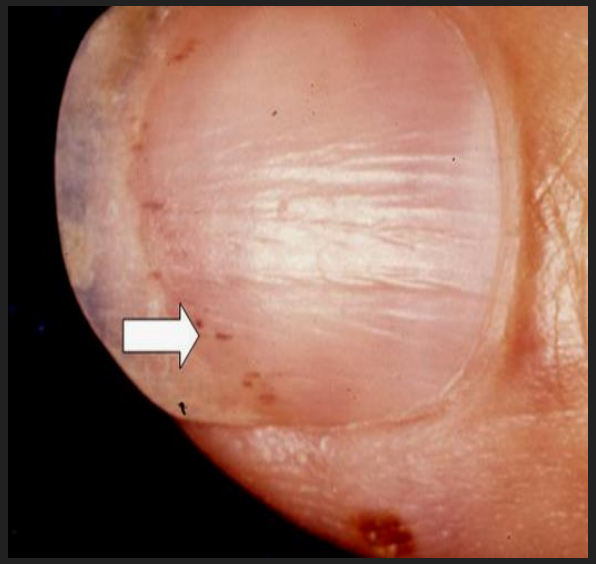
Neurovascular Examination-Blood Pressure Measurement-2

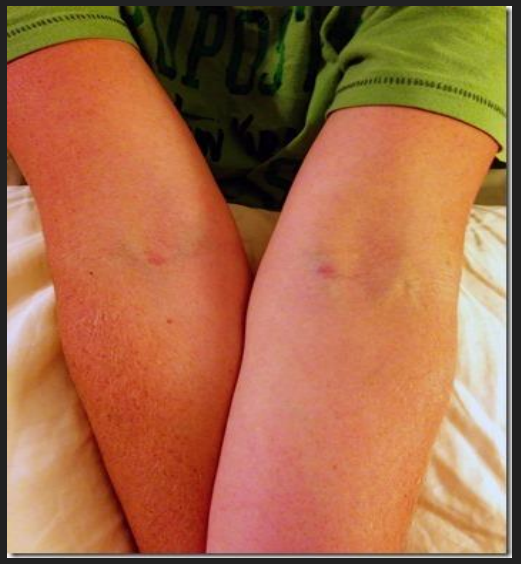
- The BP should be measured with the patient supine and then again after standing; ***several standing measurements*** may be needed because the pressure may be normally sustained for a minute or two, then fall to hypotensive levels.
- While standing, the patient should be asked to perform ***a Valsalva maneuver***. The erect position may reduce pulse pressure, and the straining may cause a decreased cardiac output, which may precipitate symptoms of insufficiency.

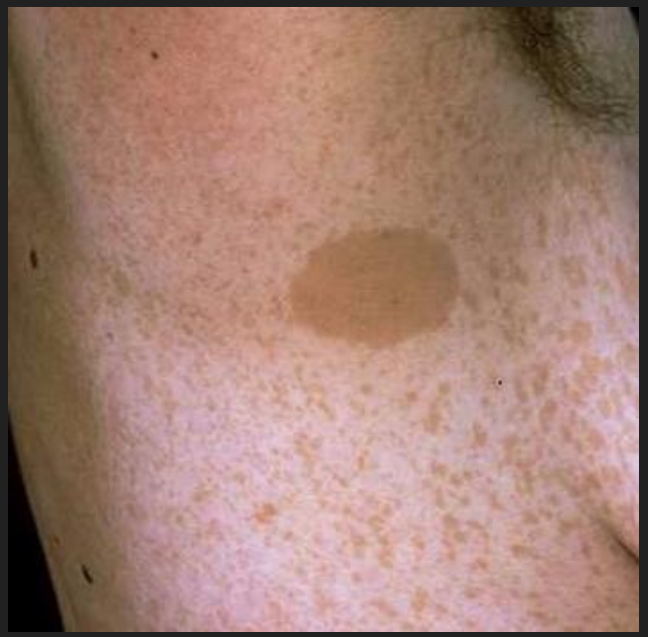
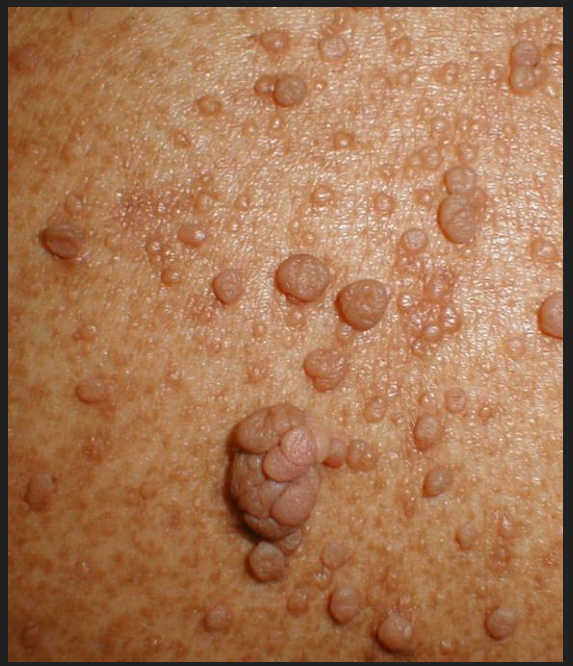
Examination clues to cerebrovascular disorers-1

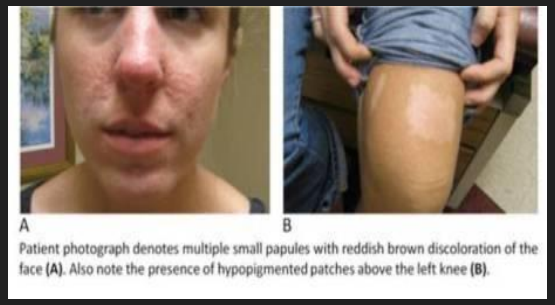
Finding	*Possible Significance*	*Stroke Type*	*Suspected Pathogenesis*
Skin			
Cyanosis	Cyanotic congenital heart disease	IS	Cardiac embolism, cerebral thrombosis (polycythemia)
Osler nodes, splinter hemorrhages	Infective endocarditis	IS, ICH, SAH	Cardiac embolism, infective aneurysm, vasculitis
Needle tracks	Drug addiction, infective endocarditis, HIV	IS, ICH, SAH	Cardiac embolism, infective aneurysm, vasculitis
Café-au-lait spots, axillary freckles, neurofibromas	Neurofibromatosis	IS, ICH, SAH	Arterial hypertension (renal artery stenosis, pheochromocytoma), moyamoya
Hypopigmented spots, ash-leaf spots, facial angiofibromas, ungual fibromas, shagreen patch	Tuberous sclerosis complex	IS, SAH	Cardiac embolism (rhabdomyomas), intracranial aneurysm
Excessive laxity	Ehlers-Danlos syndrome	IS, SAH	Aneurysm, dissection, CCF
Yellowish papules ("plucked chicken" appearance)	Pseudoxanthoma elasticum	IS, ICH, SAH	Aortic arch stenosis, aneurysm
Telangiectasias	Osler-Weber-Rendu	IS, ICH, SAH	Paradoxical embolism (pulmonary AVM), vascular malformations
Purpura	Henoch-Schönlein, cryoglobulinemia	IS, ICH	Vasculitis, hyperviscosity


Osler's Nodes
American College of Rheumatology
webrheum.bham.ac.uk/.../ default/pages/3b5.htm
www.meddean.luc.edu/.../
Hand10/Hand10dx.html
1. More specific
2. Painful and erythematous nodules
3. Located on pulp of fingers and toes
4. More common in subacute IE



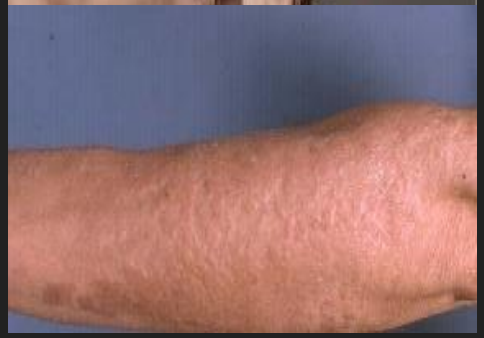


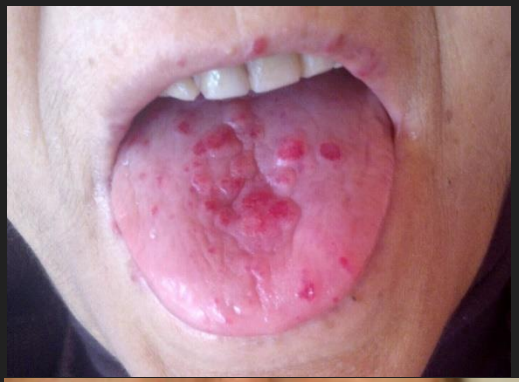




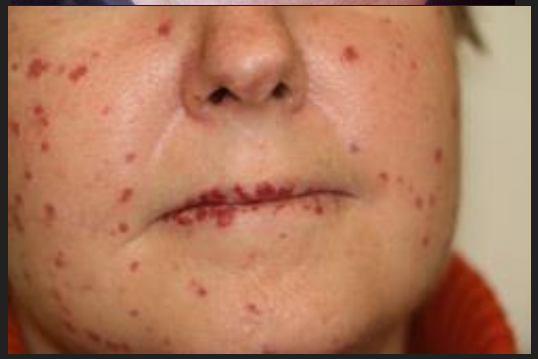


A B

Patient photograph denotes multiple small papules with reddish brown discoloration of the face **(A)**. Also note the presence of hypopigmented patches above the left knee **(B)**.

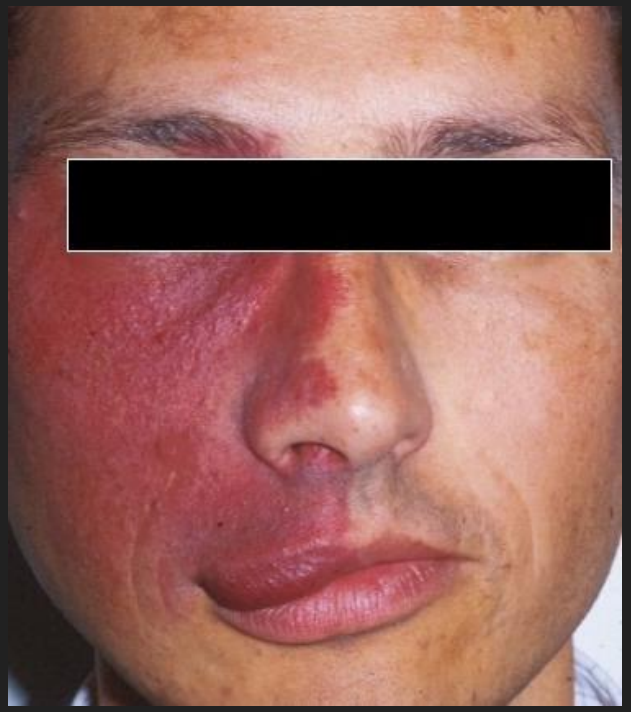


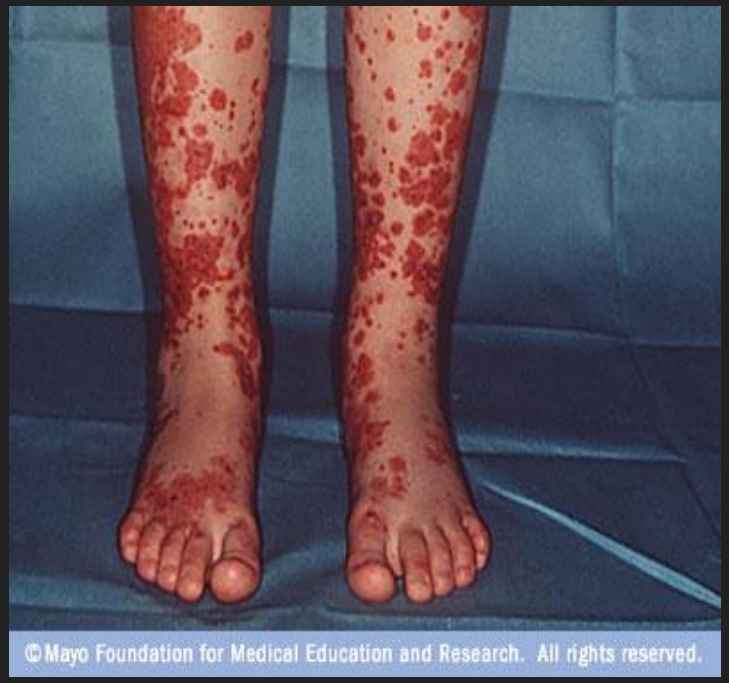




Examination clues to cerebrovascular disorers-2

Hemangiomas	Bannayan-Zonana syndrome	ICH	Brain hemangiomas (particularly cerebellum)
Upper facial nevus flammeus	Sturge-Weber syndrome	IS, CVT	Capillary venous angioma of leptomeninges, AVM
Malar skin rash	SLE, homocystinuria	IS, ICH, SAH, CVT	Prothrombotic state, vasculitis
Aphthous ulcers, oral and genital ulcers	Behçet disease	IS, CVT	Prothrombotic state, vasculitis
Angiokeratomas	Fabry disease	IS	Arterial hypertension, dolichoectasia, cardiac embolism (MI)
Livedo reticularis	Sneddon syndrome	IS	Prothrombotic state (APAS?)
Lentiginosi, blue nevi	Atrial myxoma	IS, ICH	Cardiac embolism, neoplastic aneurysm, arterial dissection
Xanthomas, xanthelasmas	Hyperlipidemia	IS	Atherosclerosis
Papules, atrophic lesions	Kohlmeier-Degos disease	IS, ICH	Prothrombotic state, vasculitis (?)
Adenopathy	Syphilis, HIV, sarcoidosis	IS, ICH	Vasculitis, vasculopathy, cardiac embolism

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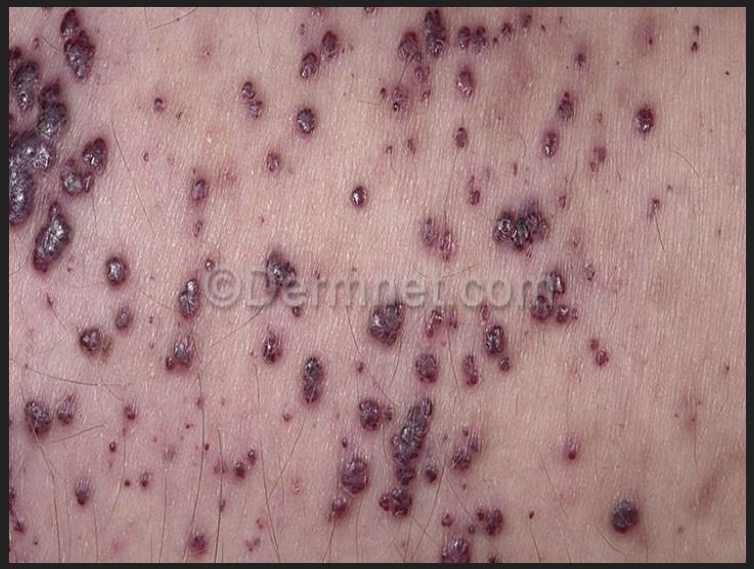
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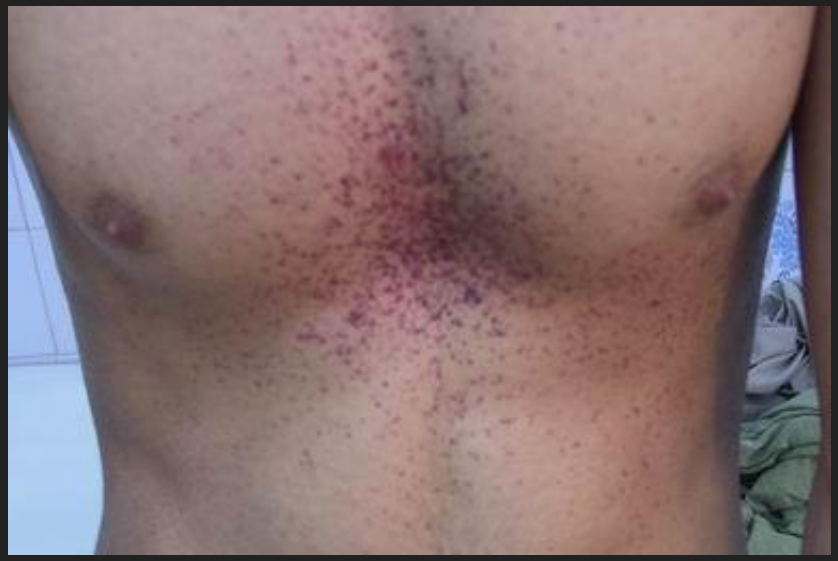

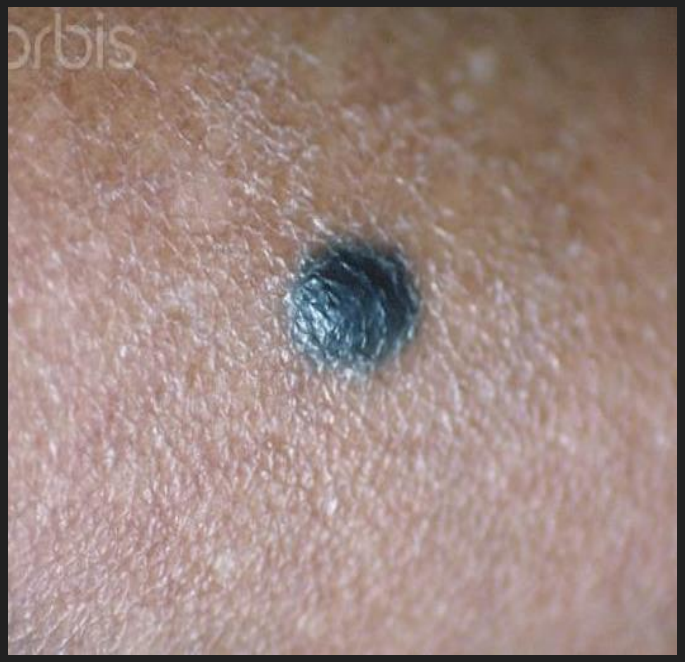
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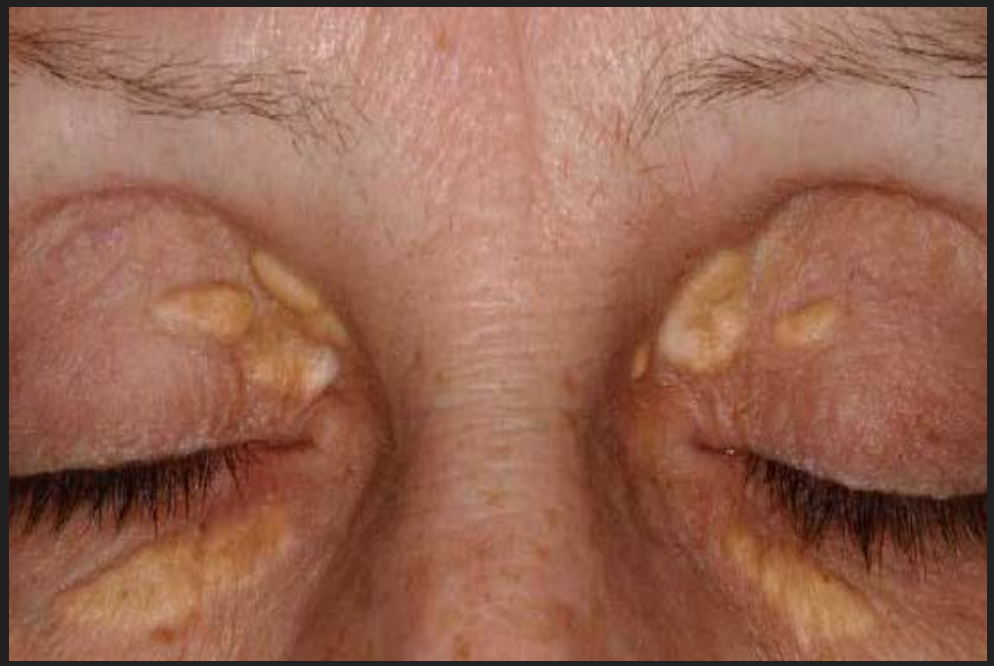
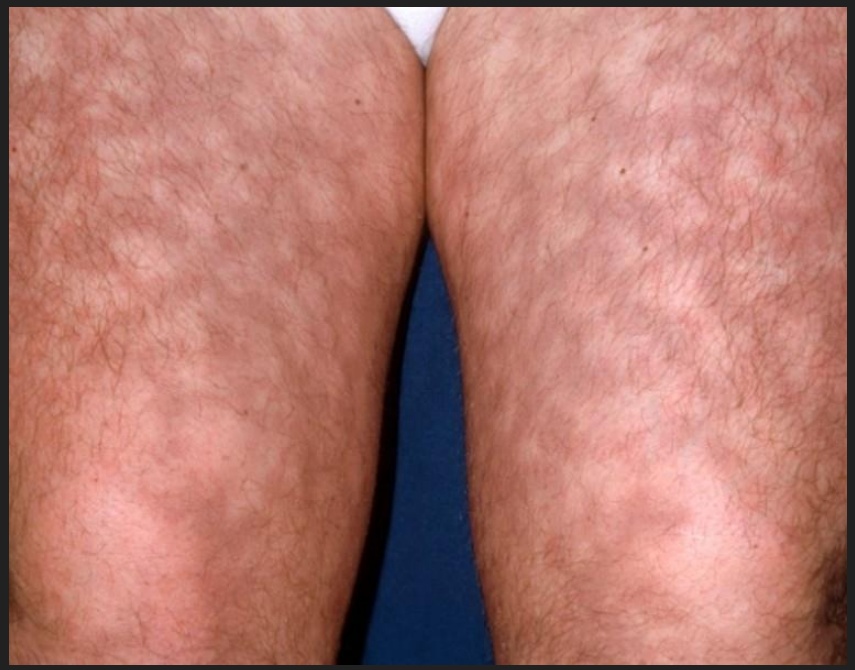
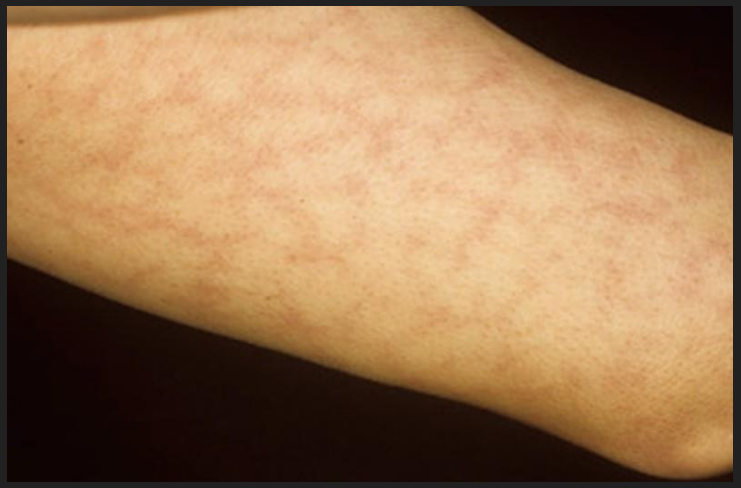






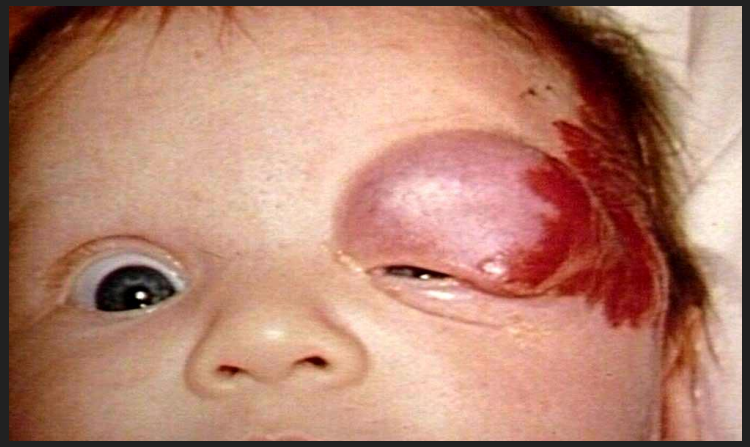
Examination clues to cerebrovascular disorers-3

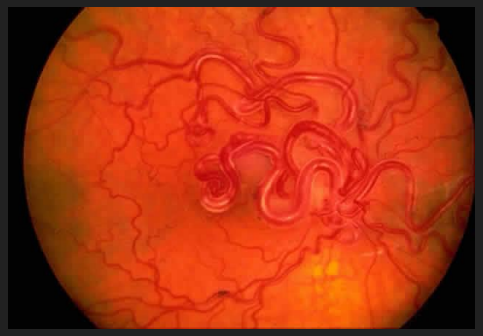
Hair			
Depigmented, brittle, twisted hair	Menkes kinky hair disease	IS, SAH	Tortuous and elongated cerebral arteries, angiodysplasia
Frontal baldness	Myotonic dystrophy	IS	Cardiac embolism
Eyes			
Horner syndrome	Cervico-cephalic arterial dissection	IS	Dissection
Pulsating exophthalmos	Carotid cavernous fistula	IS, ICH	Traumatic arteriovenous fistula
Lens subluxation	Marfan syndrome, homocystinuria	IS, ICH, CVT	Moyamoya, aortic dissection, MVP, intracranial aneurysm prothrombotic state

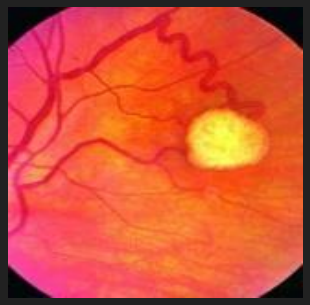
Examination clues to cerebrovascular disorers-4

Retinal phlebitis	Eales disease	IS, ICH	Vasculopathy
Retinal angioma	Familial cavernous angiomatosis, Von Hippel Lindau disease	ICH, SCI	Vascular malformation, cerebellar hemangioblastoma, polycythemia, arterial hypertension
Retinal, subhyaloid, and vitreous hemorrhages	Terson syndrome	SAH	Intracranial aneurysm
Angioid streaks	Pseudoxanthoma elasticum	IS, ICH, SAH	Aortic arch stenosis, aneurysm
Corneal arcus	Hyperlipidemia	IS	Atherosclerosis
Corneal opacity	Fabry disease	IS	Arterial hypertension, cardiac embolism (MI)
Exudates (fundi)	Diabetes, hypertension, infective endocarditis, SLE	IS, ICH, SAH	Small and large vessel atherosclerotic disease, prothrombotic state, lipohyalinosis-fibrinoid arteriopathy, cardiac embolism, vasculitis, infective aneurysm
Hemorrhages (fundi)	Diabetes, hypertension, bleeding diathesis, ruptured aneurysm	IS, ICH, SAH	Small and large vessel atherosclerotic disease, lipohyalinosis-fibrinoid arteriopathy, hyperviscosity state, intracranial aneurysm
Fat globules	Fat embolism	ICH (petechial)	Fat embolism

Von hippel-lindau disease







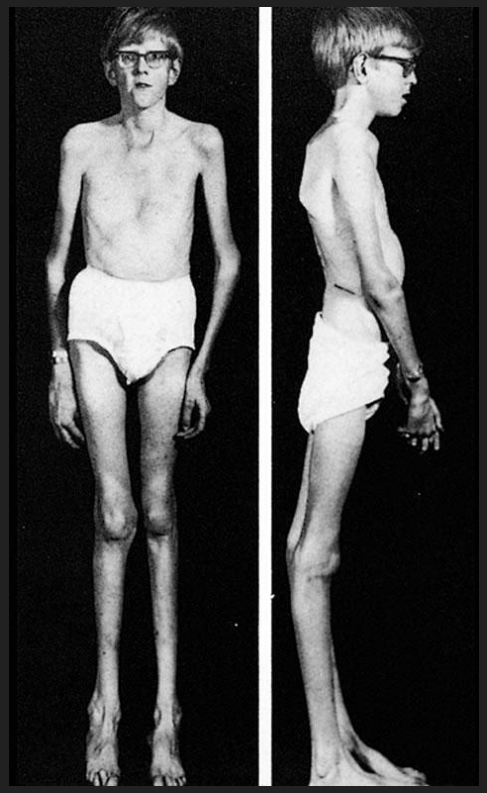
Examination clues to cerebrovascular disorers-5

Pharynx			
Tonsillar trauma	Carotid artery occlusion	IS	Dissection, thrombosis
Heart			
Murmur	Infective endocarditis, MVP, VSD, atrial myxoma, asymmetric septal hypertrophy	IS, ICH, SAH	Cardiac embolism, vasculitis, infective aneurysm
Atrial fibrillation	Nonvalvular, valvular, ischemic heart disease, cardiomyopathies, hyperthyroidism, etc.	IS	Cardiac embolism
Blood Vessels			
Diminished pulses	Premature atherosclerosis, aortic dissection, Takayasu	IS, ICH, SCI	Large vessel atherosclerosis, dissection, vasculitis
Diminished or absent femoral pulses compared with brachial pulse, upper extremity hypertension	Coarctation of the aorta	SAH	Intracranial aneurysm
Bruit	Premature atherosclerosis, fibromuscular dysplasia, arterial dissection	IS, ICH, SAH	Large vessel atherosclerosis, vasculopathy, dissection, prothrombotic state
Abdomen			
Flank mass, hematuria	ADPKD	SAH	Intracranial aneurysm

Examination clues to cerebrovascular disorers-6

Extremities			
Xanthomas	Hyperlipidemia	IS	Atherosclerosis
Venous thrombosis	Primary or secondary prothrombotic states	IS, CVT	Prothrombotic state, paradoxical embolism
Clubbing	Cyanotic congenital heart disease	IS	Cardiac embolism
Leg ulcers	Systemic vasculitis, Buerger disease, sickle cell disease	IS, ICH, SAH, SCI	Prothrombotic state, large vessel vasculopathy, moyamoya, aneurysm, vasculitis
Dactilytis	Sickle cell disease	IS, ICH, SAH, SCI	Prothrombotic state, large vessel vasculopathy, moyamoya, aneurysm
Short and broad hands, clinodactyly of the fifth finger, simian crease	Down syndrome	IS	Moyamoya
Limb hypertrophy	Klippel-Trenaunay-Weber syndrome	IS	Spinal cord AVM, cerebral arteriovenous fistula
Body Size			
Tall stature	Marfan syndrome, homocystinuria	IS, ICH, CVT	Moyamoya, dissection, prothrombotic state
Short stature	Progeria, mitochondrial encephalomyopathy, lactic acidosis, and stroke-like episodes (MELAS)	IS	Accelerated atherosclerosis, metabolic stroke

Marfan & Down syndromes



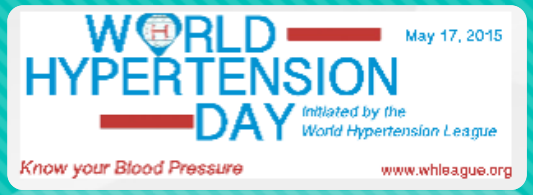
Examination clues to cerebrovascular disorers-7

Neurological			
Mental retardation	Phakomatoses, homocystinuria, hereditary or chromosomal disorders leading to cognitive impairment and stroke, Down syndrome	IS, ICH, SAH, CVT	Cardiac embolism, aneurysm, prothrombotic state, moyamoya
Myotonia	Myotonic dystrophy	IS	Cardiac embolism
Progressive external ophthalmoplegia	Kearns-Sayre syndrome	IS	Cardiac embolism
Ataxia, lower extremity areflexia, high arches	Friedreich ataxia	IS	Cardiac embolism
Deficits in multiple vascular territories	Systemic disease, cardiac disorder	IS	Cardiac embolism, vasculitis, prothrombotic state

Stroke risk factors :

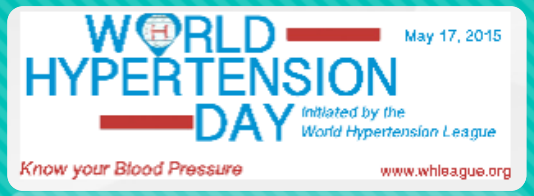
Non-modifiable	***age*** **, sex, race, FH**
Modifiable	• **HTN** • **DM: 1.5 - 3** • **Hyperlipidemia** • **Smoking: 4.1 - 11.1** • **Heart disease** • **Alcohol** • **Physical inactivity** • **Asymptomatic carotid stenosis esp. if >75%(3.3/ year)** • **TIAs esp. in first year (1-15% / year)** • **Obesity** • **Social deprivation** • **Stress** • **Diet**

World Hypertension League



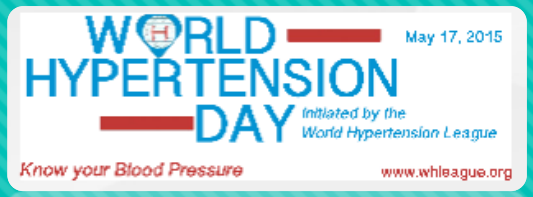
- An estimated 18% of deaths (9.4 million) and 162 million years of life lost were attributed to increased blood pressure in 2010.
- Approximately 4 in 10 adults over age 25 have hypertension and in many countries another 1 in 5 have prehypertension.
- One half of blood pressure related disease occurs in people with higher levels of blood pressure even within the normal range.
- Hypertension now disproportionately impacts low and middle-income countries.

World Hypertension League



- Unhealthy diet is estimated to be related to about ***half of hypertension*** (About 30% related to increased salt consumption, and about 20% related to low dietary potassium (low fruit and vegetables).
- Physical inactivity is related to about 20% of hypertension and obesity is related to about 30% of hypertension.

World Hypertension League



- **Alcohol and fat consumption also causes hypertension.**
- Being tobacco free is especially important for people with hypertension.
- The United Nations has agreed to a 2025 goal of reducing hypertension by 25% and dietary sodium 30%.
- The World Hypertension League aims to work with national hypertension organizations, governmental and non-governmental partners to help achieve the United Nations Targets.

Did You Know?

- High dietary salt is one of the major global health risks estimated to have caused over 3 million premature deaths, 61 million years of disability (DALYs) and 57 million years of life lost in 2010.
- Over 300 million people are estimated to have hypertension caused by high dietary salt.
- Apart from **hypertension**, high salt intake is associated with ***gastric cancer***, ***recurrent kidney stones***, ***osteoporosis***, ***obesity***, **and** ***kidney and heart blood vessel damage***.
- Adults should eat *less than 5 g of salt (2000 mg sodium*) a day. The WHO has indicated reducing dietary salt is a best way to improve health.

World Hypertension Day 2015! 17th May

- The goal for this year is to have 1 million adults receive Blood Pressure Screenings along with education to raise awareness for hypertension globally.

Definitions :

- TIA (Transient Ischemic Attack))
- Stroke
- Silent Stroke

WHO Definition of Stroke

- "rapidly developing clinical signs of focal or global disturbances in cerebral function with symptoms lasting 24 hours or longer with no apparent cause other than vascular origin."

World Health Organization: Stroke-1989;20:1407-31.

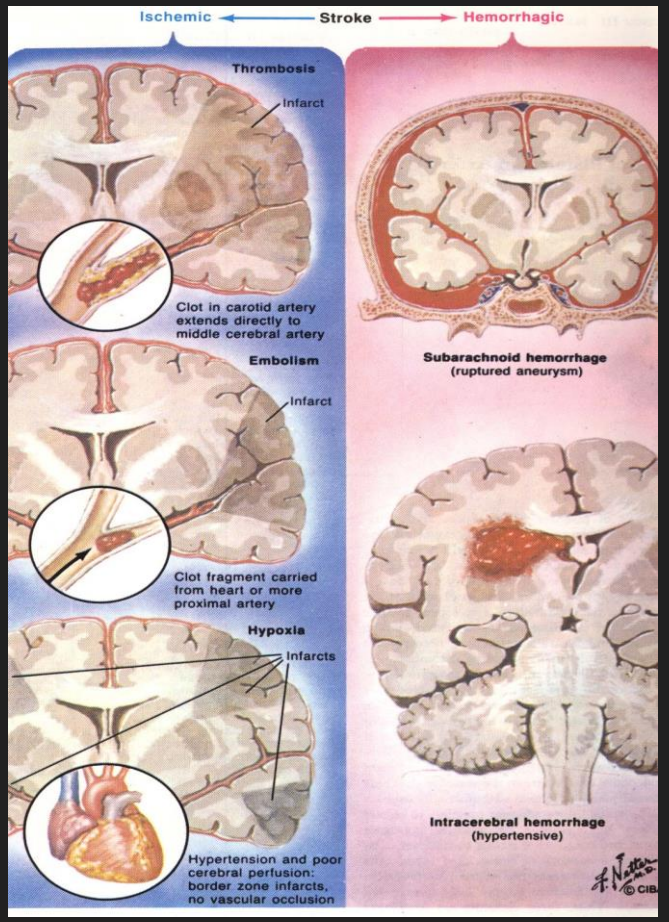
Stroke Classification:

Ischemic / TIA :

- *Atherothrombotic*
- *Embolic 1/5*
- *Lacunar 1/4*

Hemorrhagic :

- *Subarachnoid Hemorrhage(SAH)*
- *Intracerebral Hemorrhage (ICH)*



Stroke temporal profile :

- **Embolic:** suddenly, at seconds
- **Atherothrombotic:** salutatory fashion , over period of minutes, hours , occasionally days
- **ICH:** steady progressive , over period of *minutes or hours*

➡**SAH**: suddenly, at seconds & minutes

Ischemic stoke

- **Atherotrombotic:**

✓ **Atheroma tend to form at branchings & curves**

✓ **Most frequent sites:**

1) ICA

2) VA

3) MCA

4) PCA

5) ACA

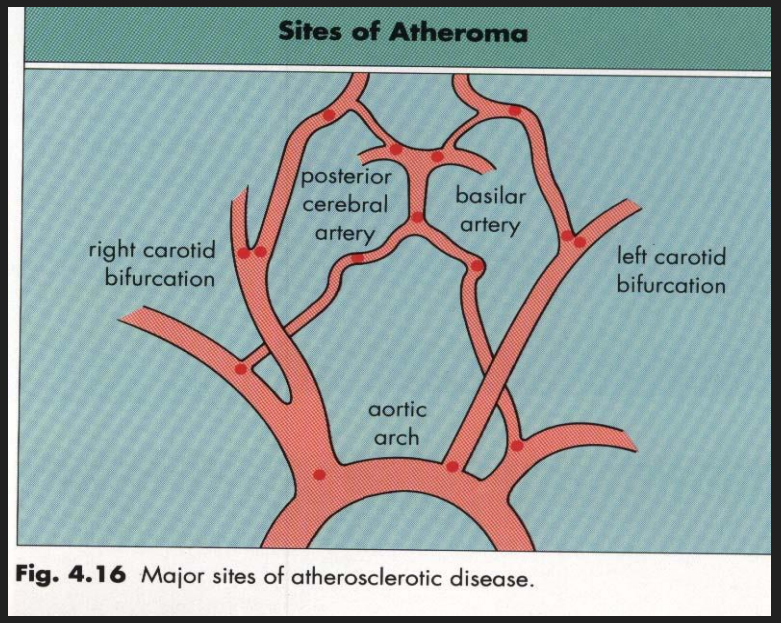
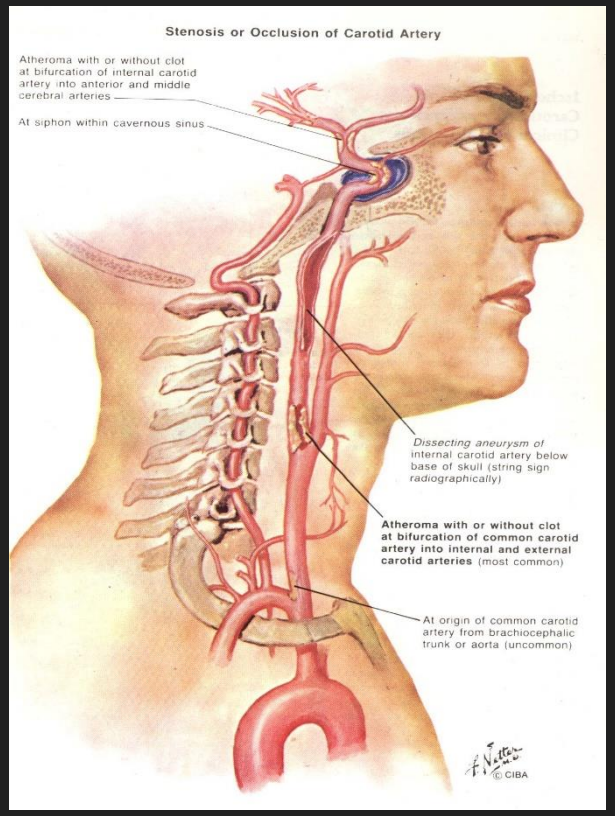


Fig. 4.16 Major sites of atherosclerotic disease.

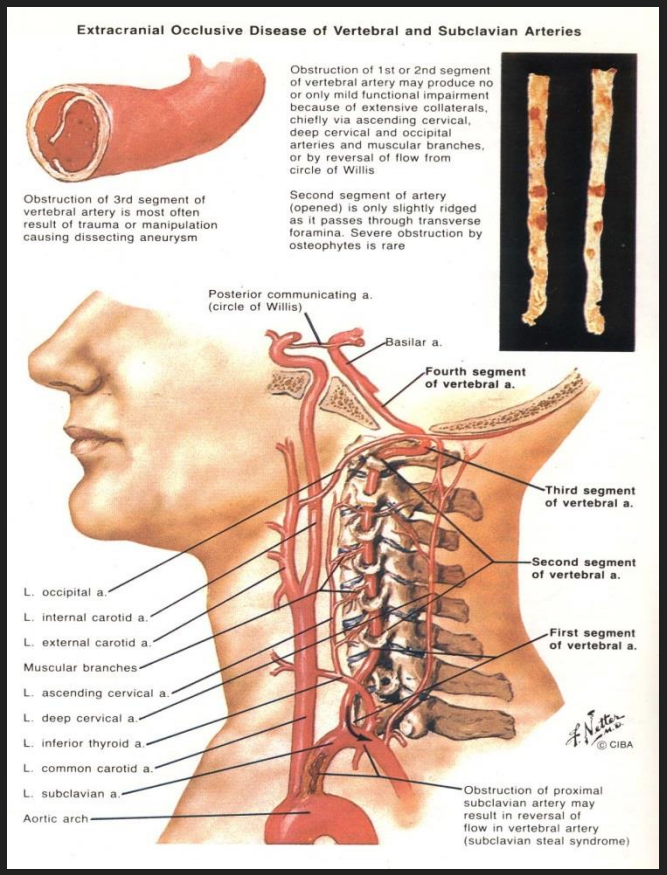
Ischemic stoke

- **TIAs: in about 75%**
- **TIAs is as *alarm***
- **Intermittency is characteristic**
- **Headache in some cases**



Mechanisms of symptoms & Signs in atherothrmbotic stroke

- Low flow
- Artery-to-artery embolism
- Steal phenomenon

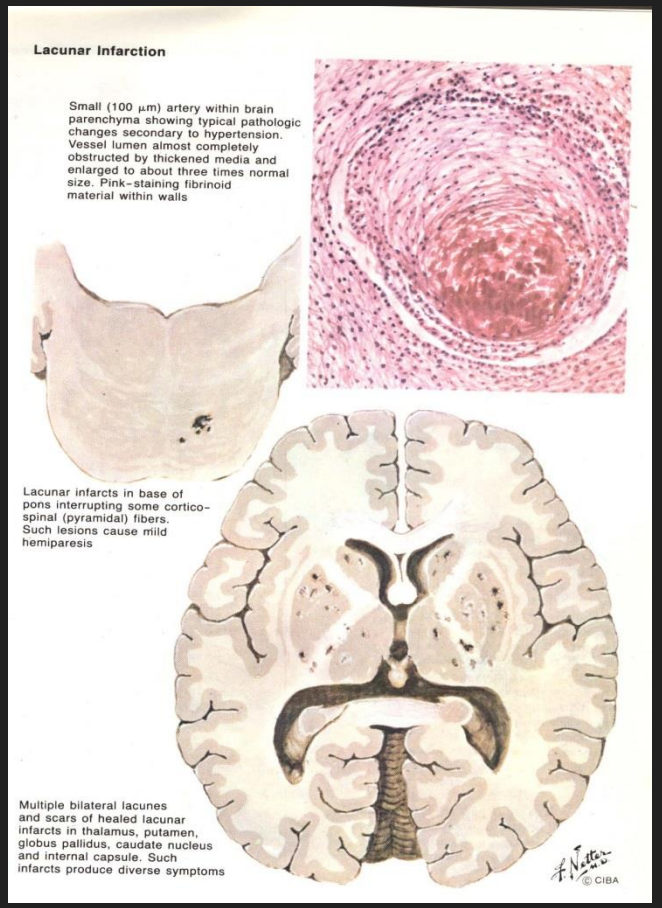


Embolic Stroke

- **Origins:**
  - **cardiac in about: 75%**
  - **non- cardiac: 5-10%**
  - **Undetermined: 20%**
- **Often emboli is small and passes in MCA branches**
- **1/20 to penetrating aa.**
- **Induce sudden FND**
- **Infarct may be hemorrhagic in 30%**

Lacunar stroke

* **Penetrating a. involvement**
* **3 - 15 mm size**
* **Limited syndromes:**
  1) **pure motor**
  2) **pure sensory**
  3) **pure dysarthria**
  4) **dysarthria & clumsy hand**
  5) **ataxic hemiparesis**
  6) **pseudobulbar palsy**



Neurovascular syndromes

Carotid system :

Ocular: TMB

Hemispheric:

R&L: hemiparesis, hemihyposthesia, dysartheria, hemianopia

L: aphasia, dysphasia

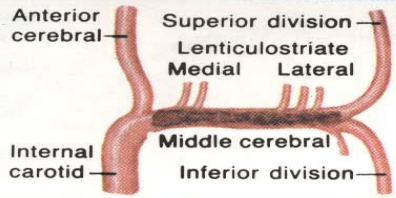
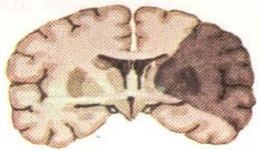
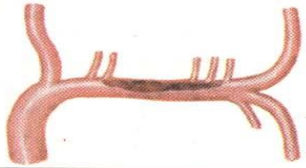
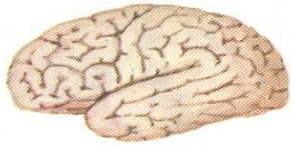
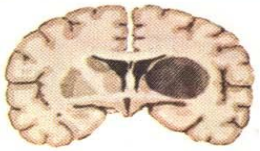
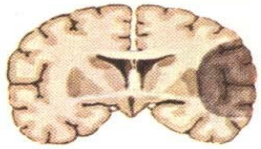
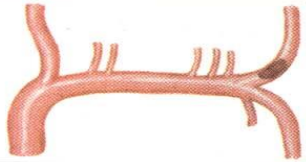
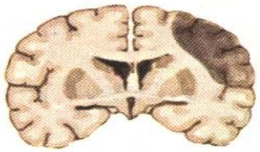
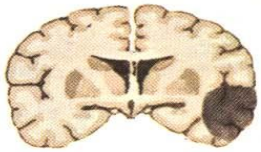
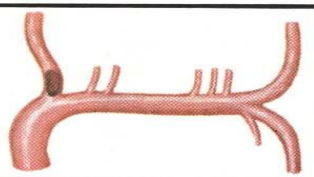
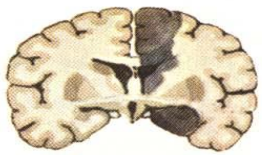
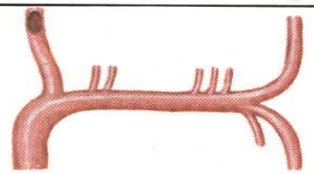
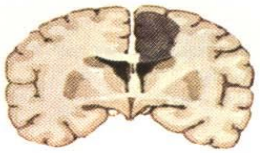
R: hemineglect, anosogenosia ……..

Vertebrobasilar system :

vertigo, nasuea, vomiting, ataxia, dysphagia, diplopia, LOC

crossed signs (Weber, Millard Gubler, Wallenberg, ….)

Occlusion of Middle and Anterior Cerebral Arteries

Lesion		Artery occluded	Infarct, surface	Infarct, coronal section	Clinical manifestations
Middle cerebral artery	Entire territory				Contralateral gaze palsy, hemiplegia, hemisensory loss, spatial neglect, hemianopsia Global aphasia (if on left side) May lead to coma secondary to edema
	Deep				Contralateral hemiplegia, hemisensory loss Transcortical motor and/or sensory aphasia (if on left side)
	Parasylvian				Contralateral weakness and sensory loss of face and hand Conduction aphasia, apraxia and Gerstmann's syndrome (if on left side) Constructional dyspraxia (if on right side)
	Superior division				Contralateral hemiplegia, hemisensory loss, gaze palsy, spatial neglect Broca's aphasia (if on left side)
	Inferior division				Contralateral hemianopsia or upper quadrant anopsia Wernicke's aphasia (if on left side) Constructional dyspraxia (if on right side)
Anterior cerebral artery	Entire territory				Incontinence Contralateral hemiplegia Abulia Transcortical motor aphasia or motor and sensory aphasia Left limb dyspraxia
	Distal				Contralateral weakness of leg, hip, foot and shoulder Sensory loss in foot Transcortical motor aphasia or motor and sensory aphasia Left limb dyspraxia

F. Netter M.D.

NEUROVASCULAR IMAGING

(NSRC)

- *1-Neuroimaging*
  - *Structural (CT, MRI)*
  - *Functional(SPECT, PET, MRS, dMRI-DWI, pMRI)*
- *2-Vascular Imaging*
  - *Noninvasive ; (TCD, Duplex, CTA, MRA)*
  - *Invasive ; (DSA, Conventional angiography)*

Transcranial Doppler (TCD)

- Doppler principle
- Velocity & direction of blood flow
- Clinical applications in stroke :
  - *detecting intracranial arteries stenosis*
  - *assessment of arterial patency*
  - *assessing collaterals activities*
  - *evaluation of vascular reserve*
  - *monitoring of vasospasm in SAH*

Transcranial Doppler

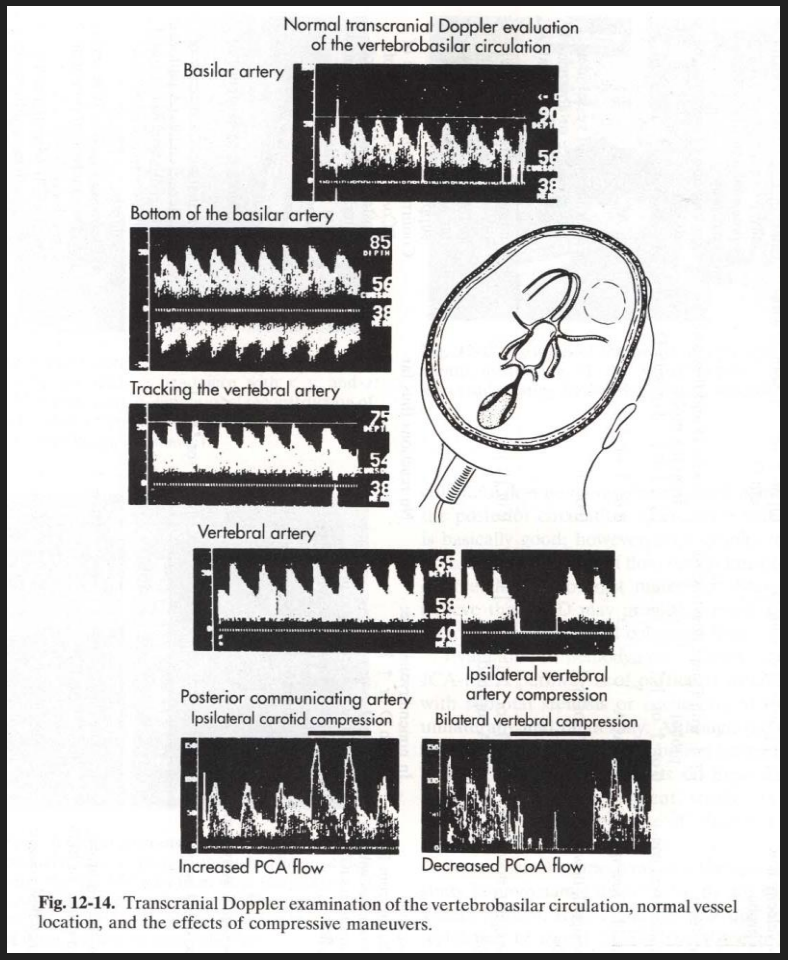


Fig. 12-14. Transcranial Doppler examination of the vertebrobasilar circulation, normal vessel location, and the effects of compressive maneuvers.

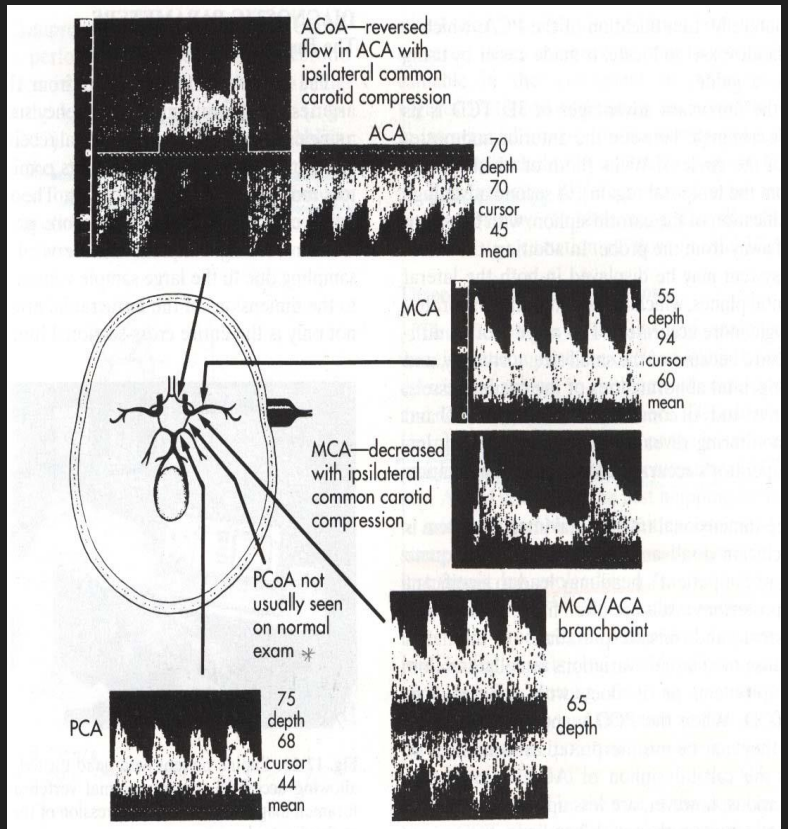


Fig. 12-13. Transcranial Doppler sonography of the basal intracranial arteries from the transtemporal approach, their normal location, and their response to compression of the common carotid artery.

Color Duplex

B -mode image & Doppler study

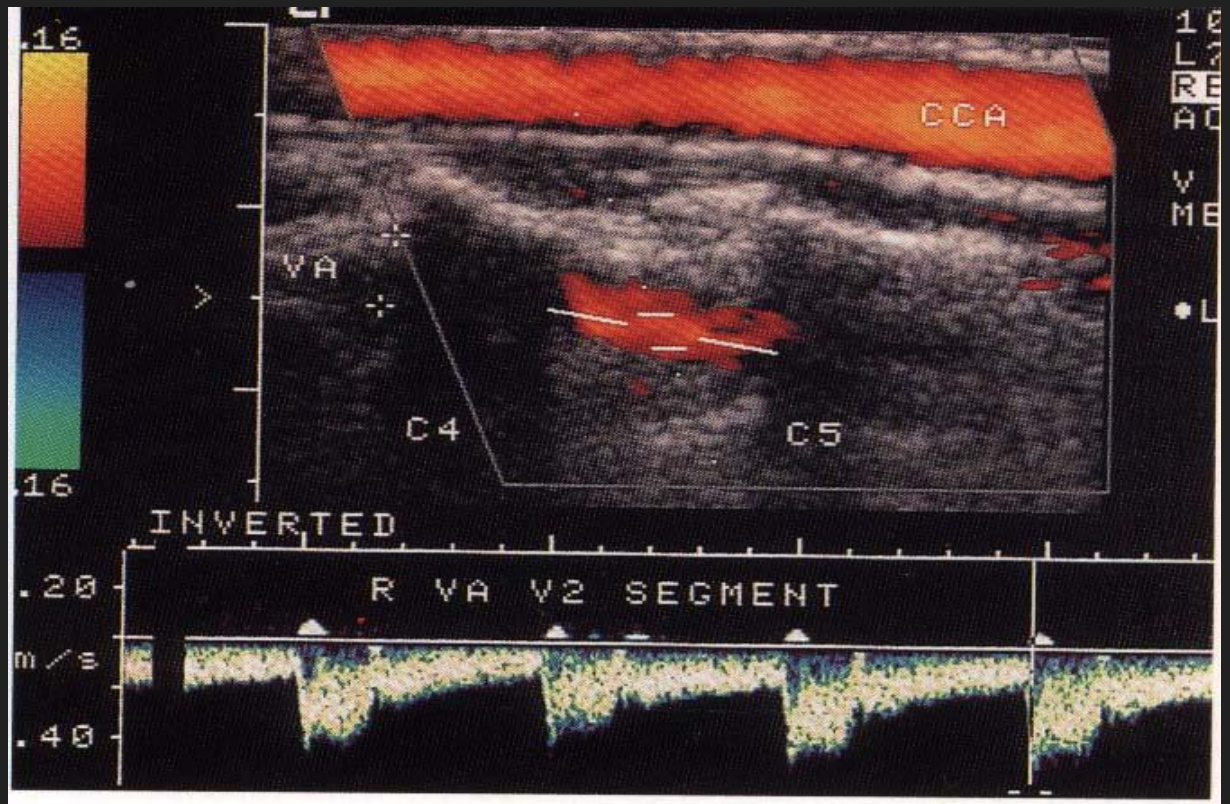


Plate 42 For legend, see Fig. 10-8 in text.

Stepwise diagnostic evaluation of TIAs /Ischemic strokes

Initial evaluation:

1)BS, 2)CBC 3) Lipid profile 4)PT, PTT 5) ESR 6) ECG

7) brain CT 8) noninvasive arterial imaging (duplex , TCD , MRA)

second step:

1) Echocardiography (Trans thoracic / Transesophageal)

2) cerebral angiography 3) antiphospholipid antibodies

Others :

1)ECG monitoring 2) ETT / thallium scan 3) CSF analysis

4) Screening of prothrombotic states

(e.g. Pr C, Pr S, AT III, thrombin time , Hb / serum protein electrophoresis)

<50 Y , DVT or FH of DVT, unexplained stroke

TIA Management

- **ABCD2** score:
- **A**ge 60 or older: 1 point
- **B**lood pressure ≥140/90: 1 point
- **C**linical:
  - Unilateral weakness: 2 point
  - Speech impairment: 1 point
- **D**uration:
  - 60 minutes or more: 2 points
  - <60 minutes: 1 point
- **D**iabetes mellitus: 1 points

4 points or more= admission

Treatment

- **Thrombolytic therapy** (first 4.5 h)*

Important notes in thrombolysis:

* Team's information and experience
* Hospital's facilities and cooperation
* Patient information
* Consent

Characteristics Of Patients With Ischemic Stroke Who Could Be Treated With tPA Less Than 4.5 Hours From Symptom Onset

Circulation 2010;122;S818-S828

Inclusion criteria

- Diagnosis of ischemic stroke causing measurable neurologic deficit
- Onset of symptoms 4.5 hours before beginning treatment
- Age ≥ 18 years

Absolute Exclusion criteria-1

- Head trauma or prior stroke in previous 3 months
- Symptoms suggest subarachnoid hemorrhage
- Intracranial neoplasm, arteriovenous malformation, or aneurysm
- History of previous intracranial hemorrhage
- Recent intracranial or intraspinal surgery
- Active internal bleeding
- Arterial puncture at *noncompressible* site in previous 7 days
- Elevated blood pressure (systolic >185 mm Hg or diastolic >110 mm Hg)

Absolute Exclusion criteria-2

- Evidence of **active bleeding** on examination
- **Acute bleeding diathesis**, including:
  - *Platelet count < 100 000/mm3*
  - *Heparin received within 24-48 hours, resulting in aPTT upper limit of normal*
  - *Current use of anticoagulant with INR≥ 1.7 or PT > 15 seconds*
- Blood glucose concentration < 50 mg/dl
- CT demonstrates multilobar infarction (hypodensity > 1/3 cerebral hemisphere-MCA)

Relative exclusion criteria*

- Only minor or rapidly improving stroke symptoms (clearingy or monotonic dramatically)
- Pregnancy
- Seizure at onset with postictal residual neurologic impairments
- Major surgery or serious trauma within previous 14 days
- Recent gastrointestinal or urinary tract hemorrhage (within last 21 days)
- Recent acute myocardial infarction (within previous 3 months)
- **Severe stroke (NIHSS > 25): in period of 3-4.5 hours**

National Institutes of Health Stroke Scale*

NEUROLOGICAL EXAMINATION	SCORE
1A. Level of consciousness (alert to coma)	0-3
1B. Month/age (both right to none right)	0-2
1C. Commands eyes open/closed	0-2
2. Best gaze	0-2
3. Visual	0-3
4. Facial palsy	0-3
5/6. Best motor arm/leg (right/left)	0-4
7. Limb ataxia	0-2
8. Sensory	0-2
9. Best language	0-3
10. Dysarthria	0-2
11. Neglect	0-2

1. Level of consciousness
0 alert
1 drowsy
2 stuporous
3 coma

2. LOC questions (month, age)
0 both correct
1 one correct
2 incorrect

3. LOC commands (close eyes, make a fist)
0 both correct
1 one correct
2 incorrect

4. Best gaze
0 normal
1 partial gaze palsy
2 forced deviation

5. Visual fields
0 no visual loss
1 partial hemi
2 complete hemi
3 bilateral hemi

6. Facial palsy
0 normal
1 minor
2 partial
3 complete

7-10. Motor (L/R arm + leg)
0 no drift
1 drift
2 can't resist gravity
3 no effort against gravity
4 no movement
UN amputation/joint fusion

11. Limb ataxia (Finger-Nose, Heel-Knee-Shin)
0 absent
1 present in 1 limb
2 present in 2 limbs

12. Sensation (pinprick)
0 normal
1 partial loss
2 severe loss

13. Best language
0 no aphasia
1 mild-mod aphasia
2 severe aphasia
3 mute

14. Dysarthria
0 none
1 mild-mod
2 near to unintelligible or worse
UN intubated/barrier

15. Extinction and inattention
0 no neglect
1 partial neglect
2 complete neglect

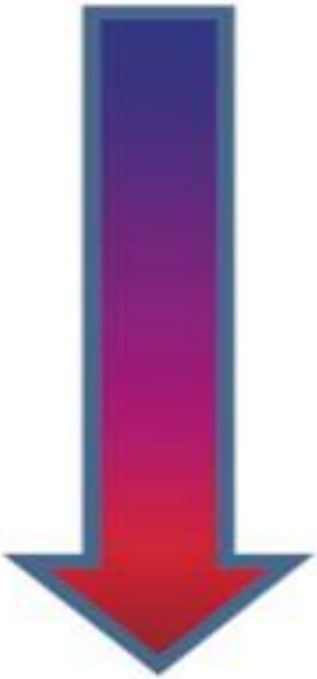
NIHSS SCORE	STROKE SEVERITY	IMPACTED BRAIN DENSITY
0	No Stroke	
0 – 4	Minor Stroke	
5 – 15	Moderate Stroke	
16– 20	Moderate to Severe Stroke	
21 - 42	Severe Stroke	

Figure 1. The National Institutes of Health Stroke Scale or NIH Stroke Scale (NIHSS) is a tool used by healthcare providers to objectively quantify and succinctly communicate the impairment caused by a stroke.

Time management

- Time is brain
- Public education
- Prehospital notification
- Fast track in hospital
- Rapid team work

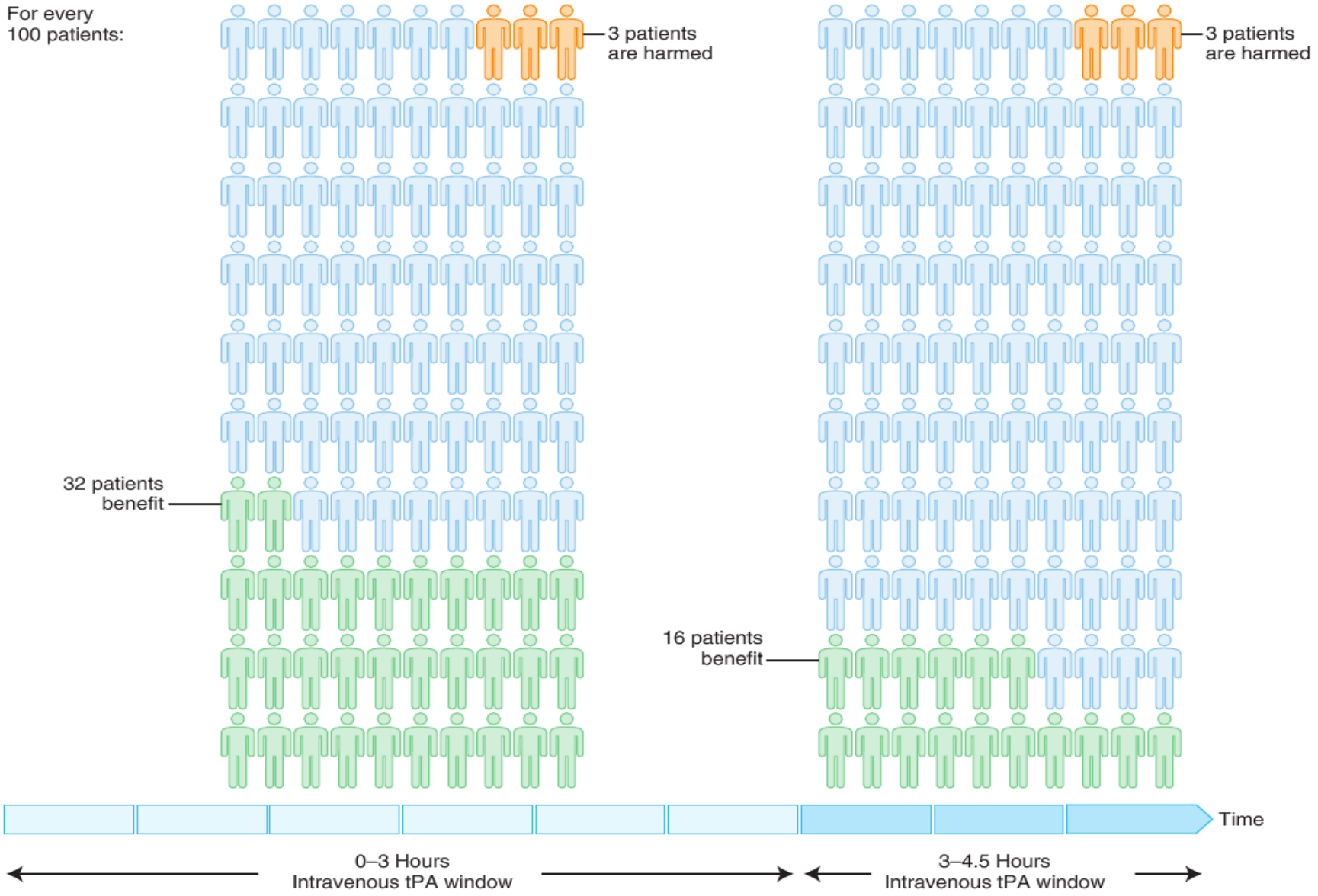
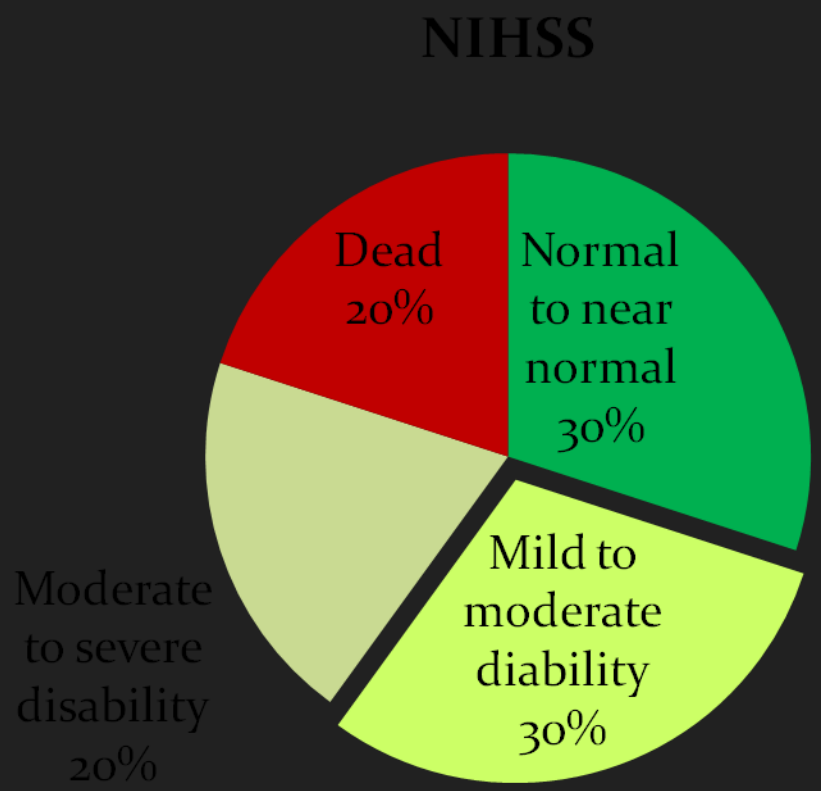


Fig. 51A.23 Risk/benefit ratio of intravenous tissue plasminogen activator (tPA) for acute ischemic stroke in the 0- to 3-hour and 3- to 4.5-hour windows. *(Created and designed by Gabriel A. Biller.)*

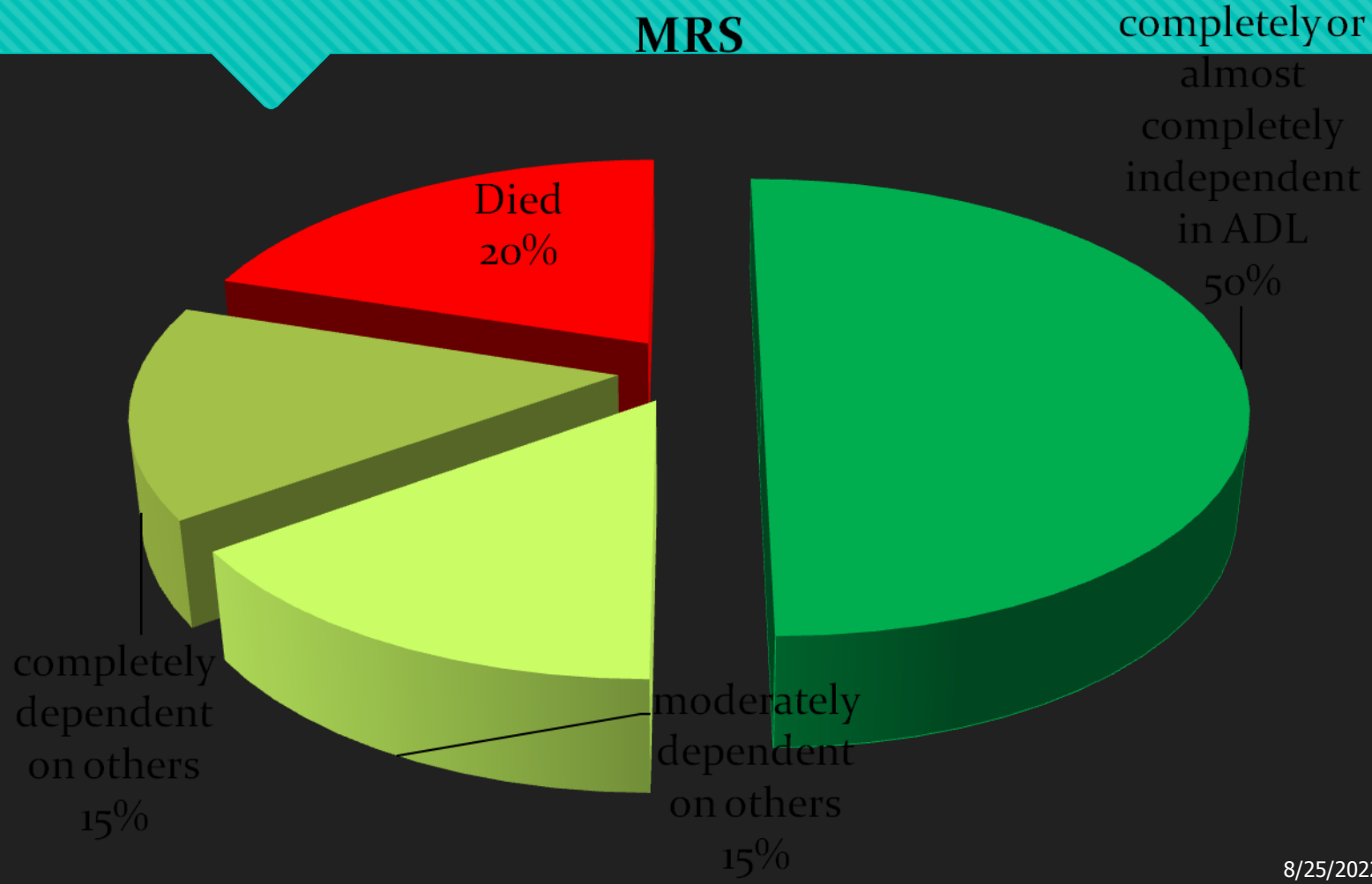
Inpatient care

- ICU / Stroke unit admission
- Close observation & evaluation
- NIH / Neurologic monitoring
- BP control & HTN management
- Guided tPA infusion
- Complications detection & management
- Physical, occupational, and speech therapy

Prognosis: Three months following tPA therapy,



Prognosis: Functional disability after 3 months following tPA therapy:



Complications

- Intracerebral haemorrhage
- Systemic bleeding (↓Hb≥1 or Transfusion need)
- Myocardial Rupture if acute MI within recent a few days
- Angioedema
- Oozing from intravenous line and venous puncture sites (up to 30% of cases)

Outcome of IV rtPA therapy:

- **Good outcome 12%: NNT= 8**
- **Any improvement: NNT=3**

- *AJNR ;March 2009 R.G.Nogueria et al*

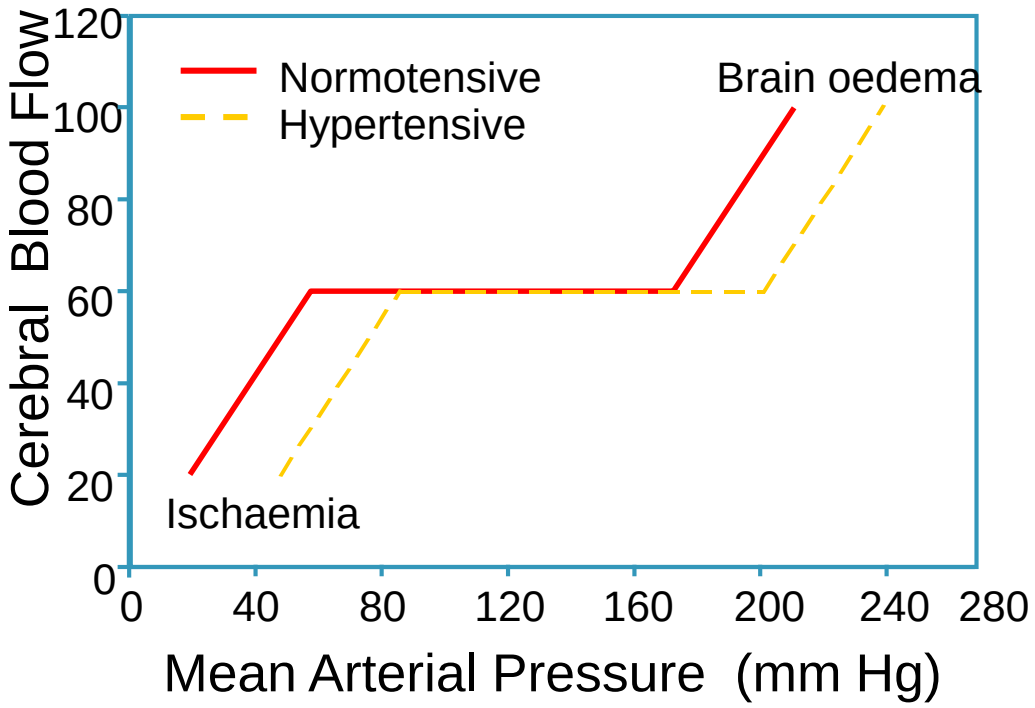
Treatment

- **Intervention / Mechanical thrombectomy** (6-24 hours)
- **Anticoagulant therapy**
- **Antiplatelets**
- **Risk factors modification**

- Hemo-dilusion
- Surgical/carotid endartrectomy
- Physiotherapy

HTN crisis control in stroke

Blood Pressure Management



- Shift toward right of the autoregulation curve in old and/or hypertensive patients
- Impaired autoregulation in the penumbra

Blood Pressure Management: "Treatable" Causes of BP Increase

- Pre-stroke hypertension
- Anxiety/Mental stress
- Urinary retention
- Pain
- Increase in ICP

Carlberg et al. *Stroke* 1991; 22 (4): 527-530.

Blood Pressure Management

- **BP lowering required only for extremely elevated values:**
  - **> 220 SBP or 120 DBP for ischaemic stroke**
  - **> 140/100 for haemorrhagic stroke**
    - *in repeated measurements*
    - *15-25% in first day*
- **Immediate antihypertensive therapy is required in case of stroke and:**
  - *Heart failure, Aortic dissection, Acute myocardial infarction, Acute renal failure, IV heparin, Thrombolysis*

EUSI Recommendations. 2002, www.eusi-stroke.com

Blood Pressure Management V

- **Recommended target BP in patients:**
  - With prior hypertension: 180/100-105 mm Hg
  - Without prior hypertension: 160-180/90-100 mm Hg
- **Recommended drugs for BP treatment:**
  - I.v. labetalol or urapidil
  - I.v. nitroglycerine or sodium nitroprusside
  - P.o. captopril
- **Avoid nifedipine and in general abrupt BP decrease**
- **Avoid or treat hypotension particularly in unstable patients** with adequate hydration and, when required, volume expanders and/or catecolamines (epinephrine 0.1-2.0 mg/h plus dobutamine 5-50 mg/h)

Blood Pressure Management

4. Avoid administering sublingual calcium-antagonists

5. In case of brain hemorrhage the thresholds for treatment are SBP > 180 or DBP > 105 mm Hg

6. Monitor the neurological status during treatment to avoid deterioration

7. Although threshold BP values to define hypotension have not been determined, in patients with dehydration or with blood pressure values that are significantly lower than is usual for the patient, the use of fluids or, in case of heart failure, the use of dopamine is recommended

American Academy of Neurology. 2000, www.stroke-site.org

Fluid / Electrolyte Balance

- Adequate hydro-electrolyte balance is essential to avoid
  - Plasma volume contraction (brain and kidney perfusion)
  - Raised hematocrit
- Virtually all acute stroke patients need hydration
- Severe electrolyte alterations are unusual in ischemic stroke
- Hypernatremia may be consequent to
  - Inadequate antidiuretic hormone secretion syndrome
  - Cerebral salt wasting syndrome
- Hypokalemia may appear during i.v. insulin infusion

Prevention of Stroke

How can I Avoid Having a Stroke?

- Avoid foods that are high in fat and cholesterol, and eat less sodium (salt), to lower your cholesterol and blood pressure.

- Recent studies show increase risk of cerebral infarction with elevated cholesterol.
- Studies show reducing LDL-C of 23-42% decreases stroke risk 29% and overall mortality by 22%.

How can I Avoid Having a Stroke?

- If you have diabetes, keep your blood sugar level under control
- Lose weight if you are overweight.
- Regular aerobic exercise-lowers risk or atherosclerosis.

How can I Avoid Having a Stroke?

- Quit smoking. If you don't smoke, don't start.
  - Overall relative risk of stroke with smokers is 1.5
  - Relative risk varied among the 3 types of stroke.

    (1.92 for cerebral infarction, 1.01 for hemorrhagic stroke and 2.93 for subarachnoid hemorrhage.)
  - Dose response between # of cigarettes smoked and RR.
  - Stroke rates drop <u>after 3 years</u> of cessation.

Pharmacologic Prevention of Stroke

Antiplatelets and Anticoagulants

- Antiplatelets work by stopping platelets from sticking to the wall of an injured vessel or other platelets.

- Anticoagulants work by blocking the formation and development of fibrin to forming a thrombus.

Antiplatelet Therapy

- Antiplatelet agents are indicated to prevent ischemic stroke recurrences in patients who:

1. have had a previous stroke or TIA and have carotid stenosis.
2. patients who have asymptomatic carotid stenosis more than 60%, and
3. selected patients with atrial fibrillation.

Antiplatelet Therapy

- Aspirin
  *Irreversibly limits platelet adhesion and aggregation.
  *Associated with a ***25%*** odds reduction overall in nonfatal stroke. It was *31% in high risk patients*.
  *Some uncertainty about appropriate dose

- Dipyridamole A platelet inhibitor, works ***synergistically*** with aspirin. Not effective against stroke alone.

Studies show the relative risk of stroke was reduced by 18% with aspirin alone, 16% by dipyridomole alone, and by ***37%*** by combination therapy

Antiplatelet Therapy

- **Ticlide (ticlopidine)**
  - Works by different mechanism than aspirin but end result is the same-platelets don't work.
  - Some studies (TASS) suggest it might be 21% more effective than aspirin by reducing strokes in high risk patients.
  - Disadvantages: Take twice a day, ***Affects bone marrow.*** Requires more lab monitoring.
- **Clopidegrol (Plavix)**

Anticoagulant Therapy for Prevention of Stroke

- **Warfarin (Coumadin)**

Effective in preventing a second cardioembolic stroke in selected patients.

Atrial fibrillation carries a **7-12%** risk for stroke each year, but on warfarin this is ***4%*** per year.

پیامبر گرامی اسلام صلی الله علیه و آله می‌فرمایند:

الشَّيْخُ فِي أَهْلِهِ كَالنَّبِيِّ فِي أُمَّتِهِ؛

هر پیری در میان طایفه‌اش همچون پیامبری در میان امتش است.

عبدالله جوادی آملی، مفاتیح الحیاة، قم، اسراء، چاپ پنجم، ۱۳۹۱، صص۳۹۸-۳۹۷.

شاد و سلامت باشید

سازمان جهانی سکته مغزی

مرکز تحقیقات علوم اعصاب

دانشگاه علوم پزشکی تبریز