

I. Review of Cerebral Anatomy

- A. Meninges - Coverings of layers of tissue within the cranium.
 - 1. Dura Mater - outer covering “Tough Mother”
 - 2. Arachnoid Mater - middle covering
 - 3. Pia mater - inner covering
- B. Lobes of Cerebral Hemispheres
 - 1. Frontal Lobe – memory judgement, behavior, personality, emotions
 - ❑ Pre-frontal area – Personality and character
 - ❑ Frontal eye fields – voluntary eye scanning movements; conjugate movements of eyes to opposite side of stimuli; voluntary fixation on object
 - ❑ Precentral gyrus – motor area – voluntary movement, opposite side of body
 - ❑ Motor Speech – Broca’s area – word formation, articulation, speed and rhythm, pronunciations,
 - 2. Parietal Lobe – primary sensory area – two point discrimination, recognizes differing pressures; shapes, forms, body orientation, pain
 - 3. Temporal Lobe – primary auditory center; interpretation of spoken word (Wernicke’s area)
 - 4. Occipital Lobe – vision
- C. Corpus Callosum - transfers information from one hemisphere to another
- D. Subcortical structures
 - 1. Internal capsule
 - 2. Basal ganglia

3. Thalamus - transfers motor & sensory information cerebral cortex
4. Hypothalamus - regulates water & temperature
5. Limbic System - several emotional responses
6. Pituitary Gland

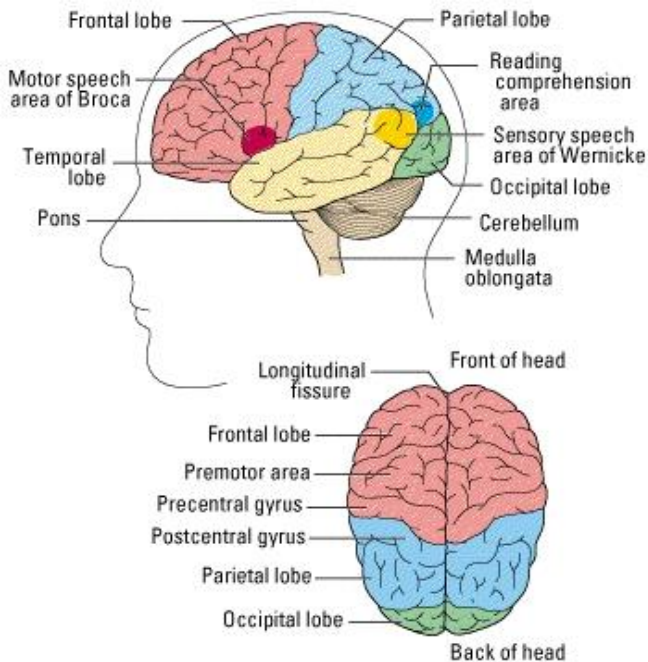
E. Brainstem

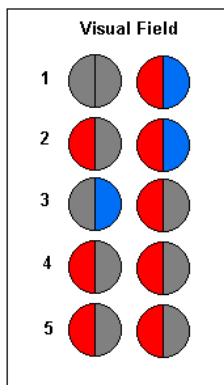
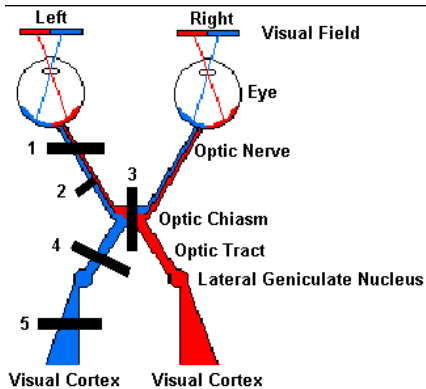
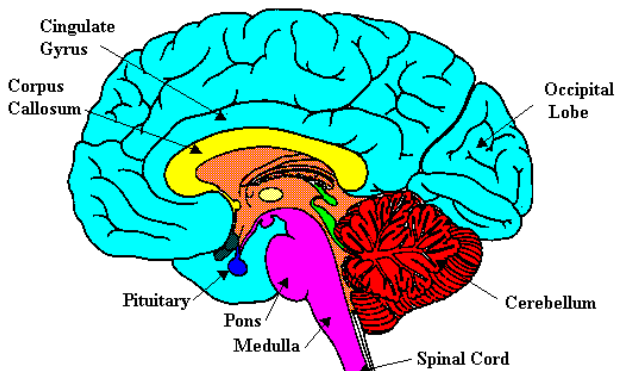
- Midbrain - motor, visual, auditory
- Pons - Critical Vital Centers , breathing patterns
- Medulla - Motor, Sensory, Cranial Nerves
Respiratory centers

F. Reticular Activating Center - the area that wakes you up and makes you alert

G. Cerebellum - The area that is responsible for our equilibrium and our fine motor movement.

The Brain





Cranial Nerve Function

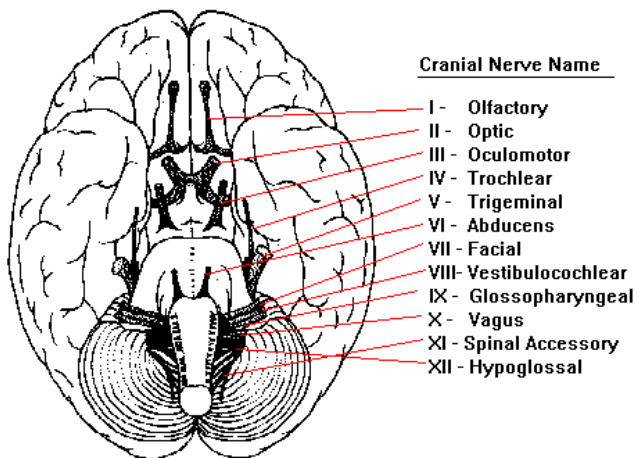
I.	Olfactory	Sense of smell
II.	Optic	Vision
III.	Oculomotor	Pupil constriction Elevation of upper eyelid
IV.	Trochlear	Responsible for extra-ocular eye movements
V.	Trigeminal	Sensory- Facial Motor- Jaw, chewing
VI.	Abducens	Responsible for extra-ocular eye movements
VII.	Facial	Sensory- Taste anterior 2/3 of tongue Motor- Facial movement
VIII.	Acousticm Vestibucoclear	Hearing and balance
IX.	Glossopharyngeal	Uvula movement
X.	Vagus	Carotid sinus reflex
XI.	Spinal accessory	Shoulder movement
XII.	Hypoglossal	Tongue movement

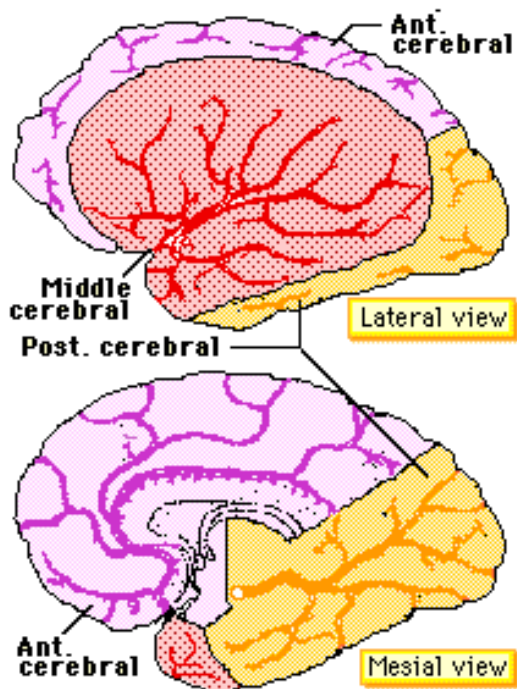
Brain Stem Reflexes

1. Corneal reflexes- V and VII
2. Oculocephalic reflex (Dolls eyes)- III, VI, VIII (make sure C-spine cleared)
 - If reflex present, eyes move to opposite side the head is turned
 - If reflex absent, eyes will move to same side head turned.
4. Pharyngeal or gag reflex- IX and X

Pathologic Reflexes

1. Plantar- normal response is flexion of toes. The abnormal (Babinski) response consists of extension of the big toe and flexion of the small toes.
2. Grasp- Grasping with stimulation
3. Snout- Puckering of lips with stimulation
4. Sucking- Sucking movements with stimulation





Distribution of Cerebral Arteries

Cerebral Circulation

1. Anterior Circulation - Internal Carotid Artery

a. Middle Cerebral Artery (MCA)

Superior branches of MCA supply these key functional areas:

- Primary motor cortex for face and arm, and axons originating in the leg as well as face and arm areas that are headed for the internal capsule as part of the corticobulbar or corticospinal tracts
- Broca's area and other related gray and white matter important for language expression--in the language-dominant (usually left) hemisphere
- Frontal eye fields (important for 'looking at' eye movements to the opposite side)
- Primary somatosensory cortex for face and arm
- Parts of lateral frontal and parietal lobes important for 3-D visuospatial perceptions of one's own body and of the outside world, and for ability to interpret and express emotions--in the nondominant (usually right) hemisphere

Inferior branches of MCA supply these key functional areas:

- Wernicke's and other related areas important for language comprehension in the language-dominant (usually left) hemisphere
 - Parts of the posterior parietal lobe important for 3-D visuospatial perceptions of one's own body and of the outside world, and for the ability to interpret emotions--in the nondominant (usually right) hemisphere
 - Optic radiations, particularly fibers that represent information from the contralateral superior quadrants and loop forward into the temporal lobe (they are located anterior and lateral to the temporal horn of the lateral ventricle) as they travel from the lateral geniculate body to the striate cortex, located in the occipital lobe
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b. Anterior Cerebral Artery (ACA)

ACA Supplies These Key Functional Areas

- septal area
 - primary motor cortex for the leg and foot areas, and the urinary bladder
 - additional motor planning areas in the medial frontal lobe, anterior to the precentral gyrus
 - primary somatosensory cortex for the leg and foot
 - most of the corpus callosum except its posterior part; these callosal fibers enable the language-dominant hemisphere to find out what the other hemisphere is doing, and to direct its activities
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2. Posterior Circulation - Vertebral-Basilar

a. Posterior Cerebral Artery (PCA)

b. Vertebral-Basilar Artery

Penetrating branches of PCA participate in supplying the following key functional areas:

- Diencephalon including thalamus, subthalamic nucleus, and hypothalamus
- Midbrain including cerebral peduncle, third nerve and nucleus, red nucleus and its connections, superior cerebellar peduncle, reticular formation

Cortical branches of PCA participate in supplying the following key functional areas:

Posterior branches to the parietal and occipital lobe

- Optic radiations and striate cortex (the primary visual cortex may be entirely supplied by PCA, or the tip of the occipital lobe where the fovea is mapped may be located in the border zone shared by PCA and MCA)
- splenium of the corpus callosum (these crossing fibers participate in the transfer of visual information to the language-dominant hemisphere)

Anterior branches to the medial temporal lobe

- Hippocampal formation and the posterior fornix (these structures are critical for laying down new declarative memories)
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Anterior Circulation Stroke Deficits

Internal Carotid - (ICA)

- a. Amaurosis Fugax

Middle Cerebral Artery (MCA)

- a. Contralateral hemiplegia/hemiparesis loss, greater loss in face and arm
- b. Contralateral hemisensory
- c. +/- contralateral hemianopia - (Right hemisphere - left visual field cuts)
(Left hemisphere - right visual field cuts)
- d. If left hemisphere more likely to have aphasia, and difficulty in reading, writing, or calculating
- e. If right hemisphere more likely to have neglect of left visual spaces, extinction of left sided stimuli, and spatial disorientation

Anterior Cerebral Artery (ACA)

- a. Contralateral hemiparesis - foot and leg worse than arm
- b. Change in affect/personality
- c. If left hemisphere +/- aphasia

Posterior / Vertebral-Basilar Circulation Stroke Deficits

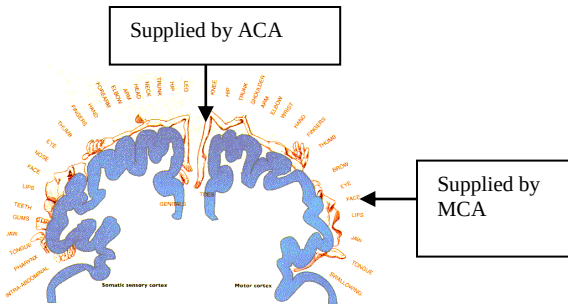
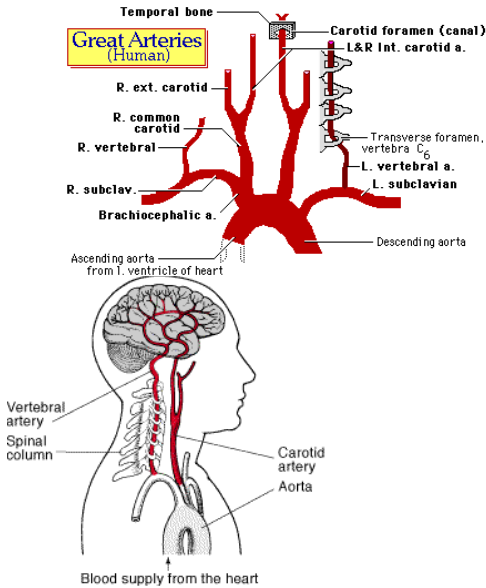
Posterior Cerebral Artery (PCA)

- a. Contralateral hemianopia

Vertebral - Basilar Artery (Any combination of these)

- a. Vertigo
- b. Ataxia
- c. Headache
- d. Nausea
- e. Diplopia
- f. Sensory loss - unilateral or crossed face/body
- g. Dysphagia
- h. Nystagmus
- i. Hemiplegia/paresis
- j. Quadriplegia/paresis

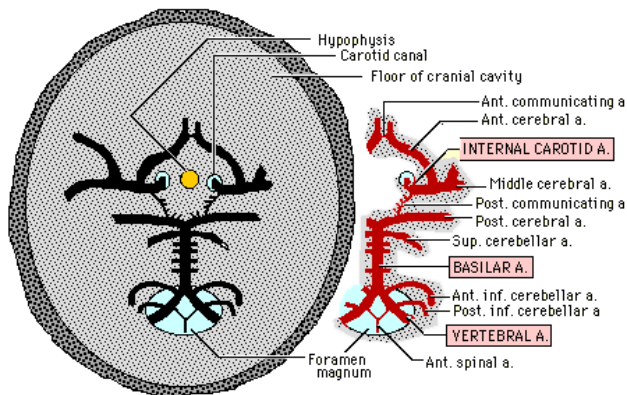
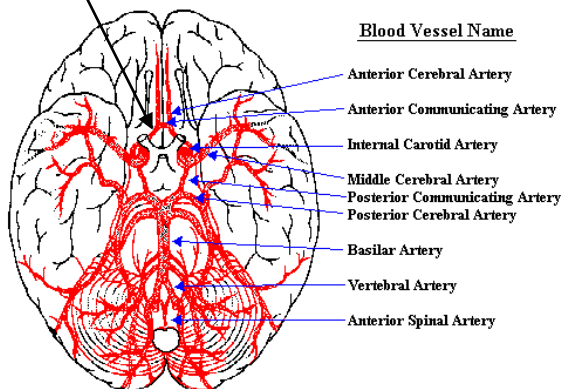
Cerebral Blood Supply



Circle of Willis:

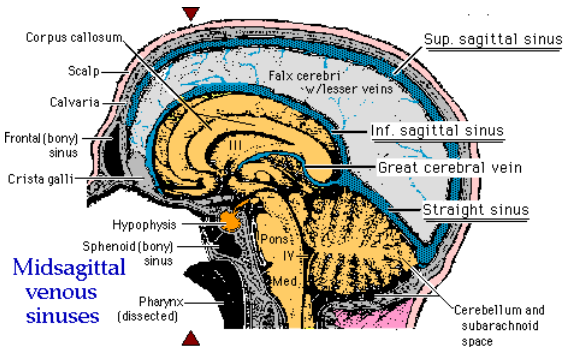
Brings the system intact to provide collateral blood flow, but also area that most cerebral aneurysms are found (i.e. at the base of the anterior, middle, or posterior cerebral arteries)

Circle of Willis



Venous Circulation

- a) Sinuses
- b) Superior Sagittal Sinus
- c) Inferior Sagittal Sinus
- d) Straight Sinus
- e) Transverse Sinus
- f) Internal Jugulars
- g) External Jugulars



Anterior Circulation Stroke Deficits

Blocked Vessel or Branch	Patterns of Possible Deficits
Extracranial Internal Carotid	Deficits depend on the extent of collateral supply and how quickly occlusion occurred. As many as 30-40% of carotid occlusions near the bifurcation are clinically silent.
MCA-main stem (M1)	• Contralateral hemiplegia and hemisensory loss • Contralateral hemianopsia • Global aphasia (L)* or denial, neglect, and disturbed spatial perception perhaps with emotional 'flatness' (R)* • Eye and head deviation toward lesion in acute stage
MCA-superior cortical division	• Contralateral Hemiparesis and hemisensory loss (face and arm more than leg; often motor more than sensory) • Expressive (Broca's) aphasia (L)* or neglect and disturbed spatial perception (R)* • Eye and head deviation toward lesion in acute stage
MCA- inferior cortical division	• Receptive (Wernicke's) aphasia (L) or denial, neglect and disturbed spatial perception (R)* • Contralateral hemianopsia-usually upper quadrants are most affected
MCA- lenticulostriate branch	"Pure motor" stroke often, but not necessarily, involving lower face, arm and leg equally but sparing sensation

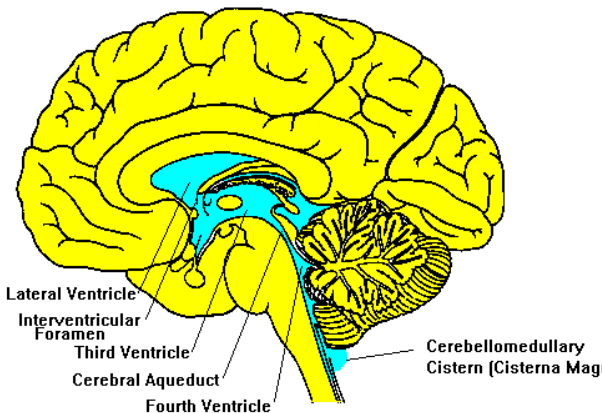
Posterior Circulation Stroke Deficits

Blocked Vessel/ Branch	Deficit Pattern
One vertebral artery in the rostral medulla in some cases, PICA branch	-termed "Wallenberg's syndrome" -sensation loss on ipsilateral side of face but contralateral trunk and limbs -ipsilateral ataxia -ipsilateral Horner's syndrome -ipsilateral vocal cord paralysis -hoarseness -impaired swallowing -vertigo, nausea, vomiting
Penetrating paramedian basilar branch in pons	-pure motor stroke -contralateral hemiplegia -involvement of face depends on infarction location
Basilar occlusion affecting the rostral pons bilaterally	-termed "locked-in syndrome" -complete bilateral paralysis rendering patient motionless and mute yet capable of perceiving sensory stimuli -vertical components of 3rd and 4th nerve function may be spared
Penetrating PCA branch supplying thalamus	-pure sensory loss -involves face, arm, trunk and leg -initially hemianesthesia but may eventually develop into thalamic pain syndrome with painful dysesthesias in affected parts
Unilateral cortical branches of PCA supplying occipital lobe	-contralateral homonymous hemianopsia -may have macular sparing (central vision) depending on location of PCA-MCA border zone
Bilateral occlusion of all PCA cortical branches distal to thalamic penetrators	-inability to form and/or consolidate new memories -cortical blindness; in acute stage, possible denial of any vision problem

Right Hemisphere CVA	
A.	Language – High Verbal
B.	Speech – dysarthria
C.	Sensation – left sensory loss • Left sided sensory loss, extinction of left-sided stimuli, tactile inattention, spatial-perceptual deficits
D.	Motor – Left Hemiparesis/hemiplegia, spasticity and apraxia
E.	Memory – Impaired recognition, or intellectual impairment, impaired judgment
F.	Perception – Spatial perceptual problems Unable to: • Judge distance, size, position, • Judge appropriately his/her own abilities and safety
G.	Behavior – Impulsive and rapid movement. Denies, indifference to, and minimizes deficits. Increased emotional lability. Integration and poor judgment. Decreased learning ability; inability to carry out learned sequential movement. Right sided CVA's highest risk of falling
H.	Left side neglect • May not recognize body parts • May not recognize they have a disability
I.	Left homonymous hemiaopsia Poor left conjugate gaze
Left Hemisphere	
A.	Language - Low verbal, Dysphasia, expressive, receptive, and/or mixed. Difficulty in reading, writing, or calculating. Impaired retention recall.
B.	Speech - dysarthria
C.	Sensation - right sensory loss Right sided sensory loss, asteriognosis, finger agnosia, right/left disorientation
D.	Motor - Right Hemiparesis/hemiplegia, less apraxic
E.	Memory - Deficit of new language information
F.	Perception - Normal awareness of right side of body, impaired depth perception, impaired right-left discrimination
G.	Behavior - Slow and cautious. Exaggerates deficits. Judgment intact, distress and depression in relation to the disability, frustration tolerance and anxiety high leading to increased emotional lability
H.	Right homonymous hemiaopsia . Poor right conjugate gaze

Cerebral Spinal Fluid (CSF)

- a. Formed: Choroid Plexus
- b. Circulates:
 - c. Lateral ventricles
 - d. Intraventricular foreman (Foramen of Monroe - this is the sight for zero referencing ventricular drains. it is located midway between the lateral aspect of the eyebrow and the tragus of the ear.)
 - i 3rd Ventricle
 - ii Aqueduct of Sylvius
 - iii 4th Ventricle
 - iv Cisterna & Subarachnoid space
 - v Foreman of Luscka & Magendie
- c) Absorbed: Arachnoid Villi (determined by hydrostatic pressure)



NIH STROKE SCALE

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1a. Level of Consciousness (Alert, drowsy, etc...)	Alert -0 Drowsy-1 Stuporous-2 Coma-3
1b. LOC Questions (Month, age)	Answers Both-0 Answers One-1 Incorrect-2
1c. LOC Commands (Open close, eyes, make fist, let go)	Obeys Both -0 Obeys One-1 Incorrect-2
2. Best Gaze (Eyes open--patient follow examiners fingers/face)	Normal-0 Partial Gaze Palsy-1 Forced Deviations-2
3. Visual or threat to patients visual field quadrants)	No Visual Loss-0 Partial Hemianopia-1 Complete Hemianopia-2 Bilateral Hemianopia-3
4. Facial Palsy	Normal-0 Minor-1 Partial-2 Complete-3
5. Motor Arm 5a. Left Arm (Elevate extremity to 90° and score drift/movement)	No Drift-0 Drift-1 Can't Resist Gravity-2 No Effort Against Gravity-3 No Movement-4 Amputation, Joint fusion-NA
5b. Right Arm (Elevate extremity to 90° and score drift/movement)	No Drift-0 Drift-1 Can't Resist Gravity-2 No Effort Against Gravity-3 No Movement-4 Amputation, Joint fusion-NA
6b. Right Leg (Elevate extremity to 30° and score drift/movement)	No Drift-0 Drift-1 Can't Resist Gravity-2 No Effort Against Gravity-3 No Movement-4 Amputation, Joint fusion-NA
7. Limb Ataxia	Absent-0 Present in One Limb-1 Present in Two Limbs-2
8. Sensory (Pinprick to face, arm [trunk] and leg - compare side to side)	Normal-0 Partial Loss-1 Severe Loss-2
9. Best Language (Name items, describe a picture and read sentences)	No Aphasia-0 Mild to Moderate Aphasia-1 Severe Aphasi-2 Mute-3
10. Dysarthria	Normal Articulation-0 Mild to Mod. Dysarthria-1 Near to Unintelligible -2 Intubated or Other- NA
11. Extinction and Inattention	No Neglect-0 Partial Neglect-1 Complete Neglect-2