

Introduction to Neuroanatomy 1: Regional Neuroanatomy

Review of CNS structure

Principles of CNS organization (the short list)

- 1) Tubular: Ventricular system of the brain and spinal cord
- 2) Spinal and Brain stem nuclei have a longitudinal organization
Nuclei; ganglia; tracts; nerves
- 3) Cerebral hemisphere nuclei, deep structures, and cortex have C-shapes
Lateral ventricle
Basal ganglia
Hippocampal formation and fornix

Development as a guide to learning regional neuroanatomy

Neural tube: 5 vesicle stage contains all CNS and ventricular divisions

Persistence of cephalic flexure; spatial terms

Spinal cord:

- Dorsal horn
- Ventral horn
- Central canal

Brain stem nuclei

- Elaboration of sensory and motor nuclei
Medial-lateral for medulla and pons
Like spinal cord for medulla

More integrative nuclei

Fourth ventricle in medulla and pons

Cerebral aqueduct (like dilated central canal) in midbrain

Diencephalon

Third ventricle

Overall C-shape, but individual nuclei are more like blobs

Cerebral hemispheres

Lateral ventricles

C-shape

Multiple divisions

C-shape of cortex

C-shape nuclei

Basal ganglia

Hippocampal formation and fornix

Summary

- 7 major divisions of the CNS; numerous subdivisions (see listing)
- Longitudinal organization of spinal and brain stem nuclei, with dorso-ventral or medio-lateral functional organization
- C-shape structures of cerebral hemisphere and diencephalon

Introduction to Neuroanatomy 2: Functional Neuroanatomy

Functional localization:

Regional neuroanatomy: spatial relations between brain structures within a portion of the nervous system

Functional neuroanatomy: those parts of the nervous system that work together to accomplish a particular task, for example, visual perception

Aims:

Functional localization of touch pathway in brain stem

To understand hierarchical organization of a neural system

To begin to become familiar with internal brain structure

Organization of visual pathway

Segue into...

Functional organization of the thalamo-cortical systems

Cortical circuitry

Dorsal column-medial lemniscal system for touch

Spinal and brain stem paths

Myelin-stained histological section

Thalamic relay nucleus

Somatic sensory cortex

Visual pathway relays through different thalamic nucleus

Cerebral cortex has two principal cell types

Pyramidal neurons—project from cortical area

Stellate neurons—interneurons (excitatory; inhibitory)

Cerebral cortex has 6 cell layers

Layer 1 mostly dendrites and axon terminals

Layer 2 pyramidal neurons to other cortical areas

Layer 3 pyramidal neurons to other cortical areas

Layer 4 input layer; from thalamus

Layer 5 pyramidal neurons to brain stem, basal ganglia and cord

Layer 6 pyramidal neurons back to thalamus

Cortical structural specializations:

Sensory cortex: prominent input layer (4)

Motor cortex prominent subcortical projection layer (5)

Association cortex prominent cortical projection layers (2,3)

Summary

- 1) Principle of functional localization
- 2) Gray matter-nuclei; white matter-tracts
- 3) Different thalamic nuclei serve different sensory and motor functions
More differences in inputs than intrinsic organization
- 4) Different sensory and motor functions served by different cortical areas
- 5) Structural specialization in cortex augment functional differences produced by different inputs

Listing of structures that will be discussed, mentioned, alluded to:

CNS Division	Components	Subcomponents	General function
Cerebral hemisphere	Cerebral cortex	Frontal lobe	motor behavior, cognition
		Parietal lobe	somatic sensation; spatial sense; attention...
		Occipital lobe	vision
		Temporal lobe	hearing, vision, smell, learning and memory
		Insular cortex	pain, balance, emotions, etc...
		Hippocampal formation	learning and memory
		Amgdala	emotions
Diencephalon	Basal ganglia	Striatum	motor control, emotions, cognition, etc
		Globus pallidus	ditto
	Thalamus		gateway to cortex
	Hypothalamus		endocrine, emotional expression, etc...
Midbrain			ocular motor control; general motor control, arousal
Cerebellum			motor control mostly
Pons			cranial sensory/motor; etc...
Medulla			cranial sensory/motor; etc...
Spinal cord	Cervical		somatic sensation; limb and trunk control
		Thoracic	
		Lumbar	
		Sacral	
Ventricular system			
Ventricles	Lateral	Intraventricular foramen	within the cerebral hemispheres
			between lateral and third
	Third		within the diencephalon
	Cerebral aqueduct		between the third and fourth
Choroid plexus	Fourth		within the hindbrain
			produce CSF
Cisterns	Quadrigeminal	Interpeduncular	dorsal to midbrain
			ventral to midbrain; between cerebral peduncles
		Cisterna magna	dorsal to medulla
	Lumbar		caudal end of vertebral canal
Planes of section			
Coronal			
Horizontal			
Sagittal			
Major axes			
Dorsoventral			
Rostrocaudal	aka neuraxis		
Mediolateral			